

HANDBOOK  
FOR THE  
9-INCH RIFLED MUZZLE-LOADING  
GUN OF 12 TONS.  
MARKS I TO VIc.

1894.



LONDON:

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,  
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# HANDBOOK

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This handbook is corrected up to September, 1894. Any alterations which may be suggested should be forwarded to Chief Inspector, Woolwich Arsenal.

# HANDBOOK

FOR THE

## 9-inch Rifled Muzzle-Loading Gun of 12 Tons.

### GUNS.

*Plates I & II.*

			Mark I.	Marks II, III, IV.	Mark V.	Marks VIA, VII, VIC.
Material	exterior	....	wt. iron	wt. iron	wt. iron	wt. iron.
	tube	....	steel	steel	steel	steel.
	nominal	in.	147	147	147	nil
Length	total	....	156	156	156	155.75
	preponderance	....	nil	5	5	5
Bore.	calibre	....	9	9	9	9
	length	....	125	125	125	125
	system	....	Woolwich	Woolwich	Woolwich	polymer
Rifling.	twist in calibres	....	I. 0 to 1 in 45 at muzzle	I. 0 to 1 in 45 at muzzle	I. 0 to 1 in 45 at muzzle	I. 1 in 30 to 45 at muzzle
	length	....	107.5	104	104	98
	number	....	6	6	6	27
Vent.	grooves	....	0.18	0.18	0.18	0.05
	depth	....	1.5	1.5	1.5	0.7
	width	....	copper	copper	copper	steel.
Chamber	description	....	radial	radial	radial	radial.
	distance from end of	....	9.7	9.7	9.7	2.5
	bore	....	cylindrical	conical	conical	conical.

A few Mark II guns have the same length of rifling as Mark I. The different marks of guns are easily distinguished from one another by their external appearance as shown in Plate I.

Mark V differs from Mark IV only in having the trunnions 0.375 inch further to the rear in order to reduce the preponderance.

(1689)

A 2



$$\text{Marks } \frac{VIA}{I}, \frac{VIA}{II}, \frac{VIA}{III}, \frac{VIA}{IV}, \frac{VIA}{V}.$$

A certain number of Marks I to V guns have been fitted with new A tubes with polygrooved rifling, and have been adapted for use with the Mark III "high-angle" mountings by having the cascade removed and the trunnions adjusted to suit guides for the gun when in the mounting. The guides are not interchangeable, and will be considered as part of the gun. Brackets fitted to the guides for attaching the gun to the oil-buffer are also considered part of the gun.

In order to facilitate identification, the Mark VIA guns will have the original mark placed below the new mark as shown above, and the original number will appear on the converted gun.

One gun designated Mark  $\frac{VI_B}{V}$  is similar to the Mark VI guns, with the exception that it is fitted with brackets to suit the Mark I high-angle mounting.

One gun designated Mark  $\frac{VI_C}{I}$  is similar to the Mark VIA guns, but is fitted with special guides to suit the Mark II high-angle mounting.

The first guns that were polygrooved were designated Mark VI. They were intended for use on what were then called "long range mountings" firing at angles up to 35°. These guns have been superseded by those for high-angle fire (except in India), and are now practically obsolete.

The Mark VIA, VI<sub>B</sub>, and VI<sub>C</sub> guns are vented so as to take electric vent-sealing tubes. The vent consists of a steel coned bush 15.4" long screwed for 9" above the cone. It strikes the bore 2.5" from the end, and is at an angle of 6° 3' with the axis, so as to be at right angles to the conical chamber. The upper end of the bush is flush with the exterior of the gun and is screwed to receive a removable head, the gun being recessed to allow of the head being screwed in. This head is furnished with a hinged cover which is intended to retain the tube when the gun is fired, and thus prevent the rush of gas and consequent erosion of the vent. The cover is retained in position when the gun is fired by a keep pin and chain. See Plate III.

A steel wrench is provided for removing the head of the vent when necessary.

A brass cover is provided for preserving the vent. The cover is in two parts, the base ring being fitted to the gun round the vent-head with a water-tight joint, and secured by fixing screws. The upper part of the cover fits over the base ring, and is secured to it by a bayonet joint on either side.

#### SIGHTS.

Marks I to V guns, when mounted behind shields or in casemates, are provided with two tangent and one centre hind sights, and three fore sights; in all other cases they have only two tangent and two fore sights.

The tangent sights are set at an angle of 44' for correction for drift. They are graduated on the face next the muzzle up to 15°, and fitted in rear with a range strip graduated in yards for a full charge and stamped with the corresponding M.V.

The deflection leaf for guns mounted on land fronts is graduated to  $1^{\circ} 30'$  left and right.

For guns mounted on sea fronts, the crosshead is fitted with a new pattern deflection leaf capable of giving  $2^{\circ}$  deflection right and left. The leaf has a vertical sight-blade of a height corresponding to a mean length of about 1,000 yards on the yard scale and also a sight notch 0.06 inch deep.

The sight-blade is intended for use in conjunction with the hydroclinometer, index-plates and readers, or any similar means of giving elevation; line only being obtained by the sights. When using the sight-blade the sight should be clamped about 1,000 yards less than the estimated range of the ship, if the ship is approaching and at the estimated range if the ship is going away, as by this means the gun can be laid for line at any time during the period the ship takes to move 1,000 yards.

The notch is for use when the elevation and line are both to be obtained by means of the sights.

The centre hind sight is graduated to  $7\frac{1}{2}^{\circ}$  and provided with a leaf giving  $30'$  deflection left and right. It is hexagonal in shape. Earlier patterns were graduated to  $5^{\circ}$  only, and the later design necessitated the deepening of the socket in the jacket of the gun. Where this alteration has been carried out the letter D has been stamped in front of the socket. The side and centre foresights are similar to one another, but the latter being rather shorter is not interchangeable with either of the former.

Each foresight consists of a pillar with removable steel acorn, a collar, and socket of gun-metal. The socket is permanently fixed in the gun; the pillar and collar each lock into it with a bayonet joint, so that when once the sight is in its true position it cannot be removed without first raising the collar and turning the pillar round a quarter of a circle.

Guns mounted on Moncrieff carriages were formerly provided with reflecting sights, one mirror being fixed on the right trunnion of the gun, the other on the carriage. These have now been abolished, and the gun is laid with the ordinary tangent sights, or by quadrant elevation and traversing arc. A trunnion plate is secured to each trunnion by studs, that on the right trunnion taking the place of the bracket of the upper mirror sight.

Mark VIA, VIB and VIC guns are not provided with any sights; they will be laid by clinometer for elevation and by traversing arc for direction.

#### MUZZLE DERRICKS.

Muzzle derricks are provided for raising the projectile to the muzzle, except in the case of guns mounted in casemates or behind shields, and of certain stations where the emplacements are provided with sunken ways and slide derricks have been approved to supersede the former pattern. They are made of bronze and consist of a band fixed round the chase at about 7 inches from the muzzle and a derrick secured to the band by two bolts. The derrick has a "bridge-piece" which rests on the gun supporting the upper part of the derrick which projects over the muzzle. The tackle should be hooked into the eye at the top with the back of the hook towards the gun, and the point through the loop to prevent the tackle from

slipping. The band is secured to the gun by four screws, two in the vertical and two in the horizontal axial plane of the gun. The derrick should be turned back on the chase after loading and always kept there when not actually in use.

#### CARE AND PRESERVATION OF GUN AND FITTINGS.

The gun should be examined after firing 50 rounds with projectiles.

The bores of guns when not in use will be lacquered; when practice is being carried out they will be kept slightly oiled, to prevent rusting. At the close of each day's practice they will accordingly be washed out and placed under metal, and as soon as dry will be oiled with a greasy sponge and the muzzles closed with tampons.

When the practice for the year is over, the bores will be lacquered, the vents plugged, and all fittings liable to damage by exposure, removed.

The clinometer planes are not to be painted, and should never be cleaned by filing or by the use of brick-dust, &c. To clean them, use a soft rag and afterwards oil them lightly.

Where guns are mounted in exposed positions the whole of the sights should be removed, and kept in store, the holes in the guns being filled with a plug of greased tow to keep out the rain and dirt. These plugs can be readily removed when it is required to fit the sights to the guns, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses.

The set-screw for clamping the centre hind-sight, not being removable from the gun, should be tested to see that it works freely.

The sights themselves should be kept clean, free from grit, and oiled; the sliding leaf of the tangent sights, as well as the jackets of the fore-sights, should have free play.

The exposed portions of the sights are bronzed if made of gun-metal, and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or blueing.

Elevating plates will be removed for transport, and the holes in the gun filled by preserving screws.

When the guns are not in use the lanyard guide will be removed, and the hole filled up with a preserving screw.

Guns fitted for land service have the friction tube pin holes and the hole for lanyard guide filled by preserving screws, and it is advisable that these screws should be occasionally removed and oiled to prevent their becoming fixed by rust.

All fixing screws should be occasionally removed and oiled.

## CARRIAGES AND SLIDES.

	Height of axis of gun in firing position.	Weight.	Diameter of trucks.	
			Front.	Rear.
<i>Carriages.</i>	ft. in.	cwt.	inches	inches
Casemate or dwarf, Mark I	—	42.25	—	—
*Mark II	—	48.0	—	—
Single plate... { casemate	—	36.5	—	—
dwarf	—	38.5	—	—
converted naval	—	44.0	—	—
Monerieff (with counter-weight)	—	530.0	—	—
High angle { † Mark I	9 6.5	416.0	—	—
† „ II	8 10.75	—	21.5	21.5
§ „ III	6 6	333.25	—	—
<i>Slides.</i>				
Casemate { rear	4 1.5	74.75	8.5	13.0
side	„	„	„	„
to work within length	„	„	„	„
single plate	„	57.75	6.0	10.5
Dwarf { „A”	5 9	97.0	18.0	24.0
„C,” central	„	110.0	24.0	„
„C,” side	„	101.5	„	„
„D”	„	107.0	„	18.0
single plate	„	174.0	10.5	15.5
7-ft. parapet, „C”... { Mark I	6 6	121.0	24.0	24.0
„ III	5 9.21	168.25	„	„
„ IV	„	—	21.74	21.74
Converted naval	4 1	60.0	5.5	12.0
Casemate E.O.C.	4 9.5	57.5	19.5	13.5
Dwarf converted E.O.C. { „A”	5 11	99.0	—	—
„D”	„	108.5	—	—
Monerieff, Mark II	14 0	272.5	30.0	††30.0

\* Formerly known as “Carriage garrison 35°, Mark I.”

† E.O.C. design. There is only one carriage of this design; it is mounted at Fort Cumberland. It is for Mark VII. gun.

‡ R.C.D. design, experimental. There is only one carriage of this design; it is mounted at Fort Cumberland. It is for Mark VIc. gun.

§ R.C.D. design. Service pattern. For Mark VIA. guns.

|| Formerly known as Slide R.M.L. 9-inch 35°, Mark III. There were only 2 mountings of Mark II pattern, both at St. Helena; they have been altered to Mark III.

†† The centre trucks are also 30 inches in diameter.

## CARRIAGE, GARRISON, (CASEMATE OR DWARF), MARK I.

The carriage consists of two wrought-iron brackets connected by a bottom plate and a transom, and strengthened by two knee-stays at the rear.

In "double plate" carriages, the brackets are formed by riveting an iron plate to each side of an iron framing.

In "single plate" carriages, the brackets are made by riveting a plate to the outside of an angle iron frame strengthened with a stay of T-iron. No more of this pattern will be manufactured.

A bracket is fixed to the front of the bottom plate for the attachment of the buffer piston rod, and two clip plates are bolted to the sides, to prevent the jump when the gun is fired.

### *Running-up Gear.*

The carriage is fitted with rollers and an eccentric shaft for "running up;" which is effected by levers inserted in sockets fixed on the ends of the eccentric shaft. For "running back," the double block of a special tackle is fitted; and the running end of the fall passes round a bollard, which is turned by gear on the slide.

### *Elevating Gear.*

There are two descriptions of elevating gear, viz.: the "worm wheel," and "capstan head."

The "worm wheel" gear consists of a worm on a shaft gearing into a worm wheel which by means of two spur pinions, actuates an elevating arc pivoted to the breech of the gun. Similar sets of this gear are fitted to each side of the carriage, and should be worked together. A metal index plate, graduated from 10° elevation to 6° depression, is secured to each side of the gun, and a metal "reader for index plate" to each side of the carriage, to show the angle at which the gun is laid. A plate, engraved with a yard scale calculated for full charge and height of battery above mean-tide level, is fitted on to the rear face of the index plates.

The "capstan head" gear consists of a capstan keyed to a spindle, on the other end of which is fixed a pinion to gear into an elevating arc pivoted to the gun. The spindle works in a bearing in the carriage bracket, and the arc is kept in gear by a metal friction roller. The capstan head has holes in its periphery for the iron-pointed levers by which it is turned, and it is clamped by a jamming lever which screws upon the end of the spindle. This gear is fitted to both sides of the carriage.

When these carriages are mounted on the 7-ft. parapet "C" slides, Mark I, a loop is fitted on each side near the trunnion bearings, to guide the rammer ropes.

### CARRIAGE, GARRISON, MARK II (PLATE VII).

The carriage is a conversion from the casemate or dwarf carriage already described, and is arranged to allow of the gun being fired at angles up to  $20^{\circ}$  elevation.

It is lengthened by the addition of pieces riveted at the rear, and the bottom plate is cut away for the gun to clear at the high angles of elevation.

The elevating gear is of the ordinary worm wheel and friction cone type already described, but the elevating arc is of increased length, having 30 teeth to give the requisite elevation.

These carriages are mounted on the 7-ft. parapet "C" slides, Marks III and IV. They are not interchangeable on account of having adjustable buffers, in which one part is attached to the carriage and the other to the slide necessitating adjustment.

### CARRIAGE, GARRISON, R.M.L., 9-INCH, HIGH ANGLE, MARK I (PLATES IX AND X).

The mounting is constructed to allow of firing at high angles of elevation from  $30^{\circ}$  to  $70^{\circ}$ .

It consists of a cradle (A), undercarriage (B, B), and elevating and traversing gears, the whole being mounted on a live roller ring.

The undercarriage is a circular platform, with two side brackets (C), the sliding surfaces of which are bolted at an angle of  $50^{\circ}$  with the horizontal; on the upper portion of these surfaces the cradle slides, and on the lower portion the recoil cylinders (H) are bolted. A roller path is fixed to the underside, and revolves on a roller ring. Front and rear clip plates formed to hook under a rim on the lower roller path are bolted to the platform, and prevent more than a trifling lift when the gun is fired.

The cradle consists of four steel castings bolted together at the centre, and has bearings for the gun trunnions, and sockets for the recoil rams. A spring bearing is fitted on each side to take the whole weight of the gun, so that it may be easily and rapidly laid. On firing the springs are compressed, and the shock of discharge is taken up altogether by the main trunnion bearings.

The recoil cylinders are of manganese bronze; each has two chambers, one for the ram (J), and the other for the necessary supply of liquid and air. The two chambers are connected by a recoil valve (P, P) and a raising valve (Q). The cylinders are provided with spring loaded valves, so that the recoil of the gun is resisted by an equal force throughout. This force is estimated to be 1,700 lbs. per square inch on the recoil rams, and is obtained by compressing the spring M with the nut V. About one-twelfth of a turn of the nut compresses the spring .011 of an inch, and varies the pressure 100 lbs. per square inch on the recoil ram. The springs are made 3.335 inches long, and when compressed to give 1,700 lbs. per square inch should measure 3.225 inches long.

The cylinders are connected by three communication pipes. The pipe (F) is fitted to the ends of the cylinders and connects the recoil

cylinders; the pipe (G) is also fitted to the cylinder ends, and connects the lower portion of the air chamber, and a smaller pipe connects the top portion of the chambers.

The recoil valves (P, P) permit the liquid to pass from the recoil cylinders to the air chambers, but not to pass back again; access to these valves is obtained by removing the covers (R). For the liquid to pass back again when the gun runs up a raising valve (Q) is provided, and this is regulated by the lever (B). Near the middle of each cylinder on the top side is an air cock (H, H), and a liquid level cock on the left hand cylinder, which indicates the level of the liquid when the gun is up. A filling cock (G, G) is fitted on the bottom side of the right cylinder.

The recoil rams are made of manganese bronze, and are secured to the cradle by pins.

The traversing gear is actuated by a hand-wheel (E), which transmits motion through bevel pinions and wheels, and a vertical shaft to a pinion which engages a rack fixed to the roller path.

The elevating gear is worked by the hand-wheels (D), which transmit motion through a train of spur wheels and pinions to the elevating arc on the gun. The fourth motion shaft (N) is driven by a friction brake of alternate steel and metal plates contained in the recess of the worm-wheel (L); the friction plates are pressed into the worm-wheel by the spring (Q, Q) and nut (P), sufficiently to ensure that no slip occurs under ordinary circumstances, but that on the gun being fired sufficient slip is given to reduce the liability of the gear to damage.

The power required on each hand-wheel to elevate or depress is about 15 lbs.

An elevation indicator is fixed to the left side of the carriage; it is of the same pattern as that described for the Mark III carriage.

A metal traversing arc is fixed to the floor of the work; the degrees of traverse are indicated by a pointer which is bolted to the platform.

With the carriage a loading trolley is issued of the same pattern as that described for the Mark III carriage.

#### CARRIAGE, GARRISON, R.M.L., 9-INCH, HIGH ANGLE, MARK II (PLATE XI).

This mounting is similar in principle to the Mark III, but it is the first one manufactured of this type, and is an ordinary Dwarf C slide, with side brackets built on it to support the cradle and gun. The cradle is fitted with two pairs of cylinders on the hydro-pneumatic principle; the gun is fitted with guides to suit the cradle, and recoils about 27 inches in the direction of its own axis at any angle; it is then returned to the firing position by compressed air. The mounting revolves on a pivot block, about a centre pivot on six trucks, and is fitted with traversing and elevating gear; a loading stage and derrick being fitted to the front part for convenience in loading. The gun and cradle are balanced in the firing position to allow of the gun being rapidly and easily elevated.

The recoil cylinders are in communication with four air chambers; during recoil resistance is obtained by controlling the outlet for the liquid, and the grooves on the face of the valves allow the air pres-



sure to return the gun after recoil. Adjustable valves and indicators are provided for regulating the length of the recoil, and the necessary filling, air, and levelling plugs, equalising pipes, and drain cocks are also provided.

The gun is elevated by worm-wheel gear, acting on a segment keyed to the left-hand trunnion of the cradle, and is set in motion by hand-wheels (A).

An elevation indicator is fitted to the right side bracket of the carriage, and is of the same pattern as that described for the Mark III carriage, page 11.

The traversing gear is actuated by a winch-handle (D) at the rear of the carriage, and transmits motion through spur and bevel gear to a longitudinal shaft with pinions, gearing with the front and rear left-hand trucks.

The loading platform consists of two steel side plates, supported by stays, and fitted with a derrick, a handrail, and a ladder for convenience in mounting.

The gun is loaded by means of the derrick, which is fitted to take a tackle for lifting the charge, which is done by a pinion and wheel actuated by the winch-handle (C). The projectile can be lowered by means of a lever on the loading stage connected to the brake strap of the winch.

The pivot block is a heavy casting firmly secured to the concrete by holding-down bolts and anchoring plates.

A traversing arc is fixed to the floor of the work; the degrees of traverse are indicated by a pointer which is bolted to the rear truck transom.

#### CARRIAGE, GARRISON, R.M.L. 9-INCH, HIGH ANGLE, MARK III (PLATE XII).

The mounting is constructed to allow of firing at high angles of elevation from  $20^{\circ}$  to  $70^{\circ}$ ; the loading position is  $20^{\circ}$  elevation. It is capable of giving  $5^{\circ}$  depression to enable the gun to be depressed when not in action, but it is not to be fired below  $20^{\circ}$  elevation.

It consists of a cradle and under-carriage, the whole being mounted on a live roller ring. The cradle carries the gun which recoils within it. It is fitted with two pairs of cylinders on the hydro-pneumatic principle, the recoil rams being fitted to the gun by means of brackets. It is mounted in the under-carriage on trunnions, and is so arranged that the gun recoils in the direction of its axis at any angle.

The cradle (a) is in two pieces bolted together, each half containing a pair of cylinders. The lower cylinders (b) in which the rams (c) work are made of metal and contain liquid, the upper cylinders (d) being of steel and containing compressed air. The upper and lower cylinder on each side are connected by a rear cap (e), which has a filling cock (f) for the passage of the air and liquid, a water-level cock (g), and a cut-off plug (h). There is also a recoil valve in each rear cap, and it is so arranged that it can be adjusted to regulate the recoil (Plate XIIA). On firing, the liquid is forced by the ram past the recoil valve into the air cylinder, thus further compressing the air in it. A small passage which is always open between the two cylinders allows the fluid to be forced back by the compressed air after recoil, and this



acting on the base of the ram returns the gun to the firing position. The air and water cylinders on either side are connected together by two pipes to equalize the air pressure, and to maintain one level for the liquid. The lower pipe for liquid, is fitted with a draw-off valve for emptying the cylinders.

The cradle is supported in the carriage by ball bearings which reduce the labour of elevating or depressing. The casings (*i*) in which the balls rotate are supported by screws and disc springs; on firing, the springs are compressed, and the shock of recoil is taken up by the trunnion bearings of the carriage, the balls being relieved by the springs.

The under-carriage (*j*) consists of a circular platform with two side brackets to take the trunnions of the cradle. A roller path (*k*) is fixed to the underside and revolves on a live roller ring. The racer (*l*) is secured by bolts and plates to the concrete of the work. Front and rear clip plates of steel are bolted to the platform and engage a rim formed on the racer.

The elevating gear is fixed to the front of the carriage. It consists of two hand wheels, (*m*) one on each side of the cross shaft, in the centre of which is keyed a mitre wheel which transmits motion through a similar wheel to a worm which gears into the elevating arc (*n*) attached to the cradle. An elevation indicator is fixed at the left side of the carriage, the angle of elevation or depression is indicated by a graduated dial plate, in the centre of which is a pointer actuated by a chain which runs in a grooved plate attached to the trunnions of the cradle; the chain is in two pieces connected by a screw coupling and a box spring, the screw coupling is to regulate the length of the chain, and the box spring to keep it taut after adjustment.

Traversing is effected by two distinct gears of the same pattern, one on each side of the carriage. Each gear is worked by a hand wheel (*o*), which transmits motion through bevelled wheels to a vertical shaft (*p*), at the lower end of which is a pinion to gear into a traversing rack fixed round the roller path. Metal arrow plates indicate the direction of traverse. A metal traversing arc is fixed to the floor of the work, and the degrees of traverse are indicated by a pointer, (*r*) which is bolted to the front of the platform.

With each carriage is issued a loading trolley, which consists of a light steel framework on four trucks. The trolley has an angle of  $20^{\circ}$  to suit the loading position of the gun. The projectile is held on the trolley by a projection which is forced up to its work by a spring during transit from the magazine. On raising a lever, the projection is drawn away from the projectile, which is then free to be rammed home.

#### CASEMATE SLIDES.

The slide consists of two girder sides connected by two transoms, two bottom plates, a top plate, and a diagonal stay; it has also four truck brackets which are bolted to the underside.

The hydraulic buffer is fixed to the slide by two holding down bands. It consists of a wrought-iron\* cylinder with piston rod and piston. The cylinder is closed at the front by a cast-iron cover and flange, and at the rear by a cast-iron cap. A stuffing box is formed

\* In future manufacture these cylinders will be of steel.

in the cover for the packing, which is tightened up by a metal gland. The cylinder is 6 feet 5.375 inches long, and 8.07 inches diameter; the piston is 8.04 inches diameter, and had four circular holes each 1 inch diameter, but one of these has been plugged up.

The quantity of oil required for the buffer is 12 gallons.

When the carriage is "run up" the piston is drawn up close to the front cover. On firing the gun the velocity of the piston is resisted by the fluid, which can only pass through the holes, and thus checks the recoil.

A zinc pan to catch the drip from the gland is suspended in front of the buffer.

#### *Traversing and Running Back Gears.*

The "traversing and running back" gears, consist of a combination of common tooth gearing, which acts directly on the two rear trucks of the casemate slide, and traverses it right or left as desired. The "running back" gear, is part of the traversing gear, combined with a revolving bollard, and special tackle.

These gears are worked independently by means of a clutch pinion, which connects or disconnects them as required.

#### *Rear Gear.*

"Rear gear" slides are worked from the rear with one winch handle.

#### *Side Gear.*

"Side gear" slides are worked from the side by two winch handles on a cross shaft at the rear of the platform.

#### *Gear to work within Length.*

"Gear to work within length" is similar to the side gear, but the cross shaft is fixed sufficiently far forward to prevent the winch handles projecting beyond the rear of the slide.

#### *Central Gear.*

"Central gear" is similar to that for "working within length," with the cross shaft fixed near the centre of the slide and connected to the rear gear by a short longitudinal shaft.

#### *Fittings.*

The slide is fitted with brackets for the side arms and iron-pointed levers, and a water-tank for the sponge head. A pointer is attached to the rear of the slide, which points to a graduated arc let into the floor of the work to indicate the angle of traverse.

### DWARF SLIDES.

The dwarf slides are the same in general construction as the casemate but are of greater height, this being obtained by the insertion of plates and packing pieces between the truck brackets and the side girders, and by the increased diameter of the trucks.

The fittings are the same as for the casemate, with the addition of steps which are fixed on each side.

On the Dwarf "A" an additional side step, 3 feet 6 inches long by 10 inches wide, is fitted to the existing side step on the right side to facilitate the reading of quadrant elevation by the elevating number.

The traversing gear for the Dwarf "A" is similar to the "rear gear" described for the casemate.

On the Dwarf "C" the front and rear trucks on the left side are geared and connected by a longitudinal shaft with bevel wheels and pinions, and are worked from the centre or side by a cross shaft fitted with winch handles.

On the Dwarf "D" the front trucks are geared by suitable wheels, and are connected by a shaft to the gear at the rear of the slide.

#### E.O.C. SLIDES.

There are a few slides mounted at out stations, constructed on the Elswick pattern, the chief peculiarity of which is that it has but three trucks, one in front and two in rear. The front truck is larger in diameter than the others, and is placed at right angles to the axis of the slide. These slides were originally fitted for the Elswick compressor; but this has been superseded by the hydraulic buffer.

Some of these slides have been converted to the service patterns of Dwarf "A" and "D" pivot, but are 2 inches higher.

#### SLIDE FOR SINGLE PLATE CARRIAGES.

The general construction of these slides is similar to that of the slides for "double plate carriages" already described, from which they mainly differ in the width between the sides and in having trucks of smaller diameter and consequently longer truck brackets to raise the slide to the requisite height.

Single plate carriages are not suitable for double plate slides.

#### CONVERTED NAVAL MOUNTING (PLATE VIII).

The carriage is of single plate construction. It is fitted with a "capstan head" elevating gear, and with a nipping gear for running up or back. The nipping gear consists of a movable block, connected by links to an eccentric which is actuated by a lever on the outside of the carriage. The block engages an endless chain on the slide, which is worked by a sprocket wheel turned by suitable gearing at the rear, so as to run the gun up or back. This gear is fixed to each side of the carriage. The eccentric axles for the rear rollers fit in hexagonal sockets riveted to a connecting bar; this bar has suitable holes for two iron pointed levers, and is prevented from going too far forward by two iron stops, which are fixed to the bottom plate of the carriage.

The carriage was originally fitted with compressor gear, but this is superseded by a hydraulic buffer in tension, which is fixed along the underside of the carriage by an iron band in front, and a metal bracket at the rear, the piston rod being secured to the breast of the slide.

The buffer consists of a steel cylinder 6.07 inches internal

diameter, and 6 feet 3.375 inches long, fitted at each end with a wrought-iron cap. A stuffing box is formed in the front cap, and fitted with two metal glands for the cotton and leather packings. The piston rod is 2.5 inches diameter, and 7 feet 4 inches long. It screws into the piston, which is 6.05 inches diameter, and has four holes for the passage of the fluid, each of which is 0.5 inch diameter.

The action of this buffer is the converse of the compression buffer, viz.:—When the gun is in the firing position, the piston rod is home in the cylinder. During recoil the piston rod is drawn out, and the fluid passes from the front to the rear of the piston.

The slide is altered from  $2\frac{1}{2}^{\circ}$  to  $4^{\circ}$  slope. It is strengthened by iron plates fixed to the breast and top, also by a steel plate riveted along each side of both girders.

Two pivot joints are bolted to the top, to which a pivot bar is attached by steel pins, the front of the pivot bar being secured to a pivot block by a steel plug.

Bottom plates are riveted to the girders for the attachment of the truck brackets, between each pair of which two iron trucks of equal diameters run.

The traversing gear consists of a pinion and shaft, turned by a crown wheel which is set in motion by a pinion worked by a winch handle at the side of the slide.

Two footboards for use when laying the gun are fixed inside the slide at the rear.

#### SLIDE, 7-FEET PARAPET, "C," MARK I (PLATE VI).

This slide is the Dwarf "C" with a loading stage and derrick fixed to the front, and the traversing gear rearranged, so that the gun can be loaded and traversed from a sunken way.

##### *Loading Stage.*

The loading stage consists of two angle iron supports bolted to the front of the slide, on the top of which a wooden floor is laid. Two steps are fixed to each side, and four stanchions with hand rail at the front.

Two steel derrick brackets are fixed to the front of the slide (one at each corner) in each of which the pillar of a loading derrick revolves. The derrick is hinged to the pillar so that it can be folded down under cover. The top of the pillar is fitted with a catch to fix the derrick in position while loading, and a check chain to prevent it falling too far forward when not in use. The derrick bracket is fitted with a projection to hold the snatch block of the loading tackle.

##### *Traversing Gear.*

In the traversing gear, the cross shaft and short longitudinal shaft are removed, and the gearing at the rear slightly modified and supported by a long bracket, so that it can be worked from the sunken way.

#### SLIDE, 7-FEET PARAPET, "C," MARK III (PLATE VII).

The slide is a conversion from the dwarf slides already described. It is strengthened to withstand the downward shock of discharge by

two longitudinal girders riveted to the underside of the existing side girders.

Two thrust blocks are further fitted to the underside of these girders, about midway between the front and rear racers, to assist in sustaining the shock of recoil. Each block consists of a wooden block faced with an iron plate on the underside, and fitted above with a cast steel bracket, on the top of which revolves a capstan head for actuating a screw, working in a thread cut in a steel casting fixed to the slide. When the capstan heads are turned, the thrust blocks are forced down on sweep plates bolted to the radial arms of the racer.

The slide is fitted at the front with a box girder, which with the thrust blocks takes the downward shock of recoil. The front truck axles are each fitted with levers, the outside ends of which are pivoted to a bracket riveted to the slide, and the inside ends are joined in the centre by a connecting block. When it is required to traverse the slide, the connecting block is forced down by a screw, which is turned by a capstan head actuated by levers, thus raising the slide and bringing the trucks into play.

The racer is fixed to the top of a bedding plate, which is connected by eight radial arms to a ring fitted over the pivot block.

The slide is provided with two compression buffers, fixed along the girders at the rear of the slide; they are fitted with taper bars, which gradually close apertures in the pistons to give an approximately constant pressure during recoil. The area of apertures in the pistons can be altered by turning the piston rods through an angle, so that the resistance to the flow of the liquid may be adjusted to suit varying charges. The piston rods are connected to the carriage by brackets, and are turned by means of a connecting bar, which is attached to their front ends by short levers; a graduated scale is fitted on the front transom of the carriage to indicate the amount of the adjustment made. The adjustment of the buffer for varying ranges will be in accordance with that laid down on page 54. Great care must be taken after each adjustment to firmly secure the clamping nut of the adjusting gear.

A fixed loading stage and rear gear for sunken way are also provided of similar design to that described for the 7-foot parapet slide, Mark I, on page 15.

#### SLIDE, 7-FEET PARAPET, "C," MARK IV.

This slide is the same as the Mark III, except that the trucks are coned and the thrust block round instead of rectangular, so that the slide can be mounted on Major Clark's combined pivot and racer.

#### RACERS.

The racers are of wrought-iron. In section they are 2.25 inches deep by 2.875 inches wide, with a flange 0.75 inch deep at the bottom of each side.

A stop in the form of a  $\frac{3}{8}$ -inch screw, with a head 1 inch diameter

and 1 inch high, is screwed in the end of the racer, to prevent the slide running off.

For the converted naval mountings the racers are flat on the surface and rectangular in section.

The 7-ft. parapet mounting Mark IV has a racer of the same section as the 10-inch service racer. It is fixed to the top of eight flanged radial arms, which are firmly bolted to the pivot block. On the top of the radial arms a steel sweep plate is bolted, on which the thrust blocks of the slide bear.

The high-angle mountings, Marks I and III, are mounted on a combined roller path, clip ring and traversing rack. The Mark II is mounted on a pivot block to which is fixed a steel racer of special pattern.

#### *Radii of Racers.*

Pivot.	Front.		Rear.	
	ft.	in.	ft.	in.
"A" ... ..	6	3	16	6
"A" (Elswick pattern casemate) ...	5	5 $\frac{1}{4}$	16	6
"C" (centre) ... ..	5	5 $\frac{3}{4}$	5	5 $\frac{3}{4}$
"D" ... ..	9	0	2	3 $\frac{3}{4}$
Converted Naval ... ..	5	1	13	6
7-ft. parapet, "C," Marks I, III, and IV.	5	5 $\frac{3}{4}$	5	5 $\frac{3}{4}$
High Angle, Mark I ... ..	4	9	4	9
"    Mark II ... ..	5	5 $\frac{3}{4}$	5	5 $\frac{3}{4}$
"    Mark III ... ..	4	4	4	4

#### HANDPOSTS AND SIGHTING STEPS.

A hand post and sighting step are fitted to the rear of each slide, to facilitate firing at moving objects. These fittings will form a standing place for the Gun Layer where he will be safe from the recoil, and from which he can look over the sights and signal to the Gun Captain when he is on the target, after the command "Commence Firing," from the Group Officer. These fittings will not be suitable for slides with rear traversing gear, or where the clearance between the rear of the slide and the piers is very limited.

#### ARCS, TRAVERSING, AND POINTER.

To indicate the angle of traverse, a pointer is attached to the rear of the slide, which points to a graduated arc let into the floor of the work.

The arcs which are of metal, cast with figured graduations, are of two patterns.

The first pattern is graduated from 0° on the left to the greatest possible angle of traverse on the right, but in casemated batteries they are so graduated, that when any two guns are parallel their pointers will indicate the same graduation. In this case also, the zeros are on the left, and are so placed as to indicate the extreme right hand line of fire of the battery.

The second pattern differs from the above, in being made in two sections, with the graduations on one section, and the figures on the

other. This system renders the half and quarter degrees more distinct, and enables the zero line of the arc, which in all new works (casemate or otherwise) will be in the direction of true north, to be truly laid, and the figured section arranged to correspond.

Slides mounted in works furnished with this arc, will be fitted with a new pattern pointer, which slides in the loops of a metal bracket, and is so arranged that it can be raised up, and held clear of any casual obstruction on the works, by means of a projection on its side. The pointer bracket is bolted to a knee bracket, which is fixed to the slide by bolts.

### MONCRIEFF MOUNTING (PLATE XIII).

This mounting is constructed for loading under cover, and to store up the force of recoil for raising the gun to fire over the parapet. For this purpose the gun is placed in an "elevator," the other end of which is fitted with a heavy counterweight. The "elevator" has a rocking movement on the slide, and when released by a retaining gear, immediately lifts the gun to the firing position.

On firing, the force of recoil overcomes the inertia of the counterweight, and brings the gun down under cover of the parapet, where it is held by the retaining gear until ready for raising.

#### *Retaining Gear.*

The "retaining gear" consists of a rack on each side of the slide, attached to the "elevator" by a connecting bar. The rack works in a guide along the top of the slide, and gears into a brake drum which is fitted with a ratchet and pawls, so that it can move in one direction while the gun recoils, but is held in that position until released by relaxing the brake band.

#### *Elevating Gear.*

The "elevating gear" is fitted to the slide and attached to the gun by connecting rods. The connecting rods move in a guide, one end of which is pivoted to a support, the other end being fitted with an elevating arc, which is actuated by a pinion. The pinion is keyed to a short shaft, the other end of which passes through the right girder of the slide, and has upon it a worm wheel which is worked by a worm shaft, fixed vertically to the side, and turned by a hand wheel. The worm wheel is recessed out, and fitted with two friction cones, which by allowing a certain amount of slip, prevent damage to the gear by the shock of discharge. An index plate is attached to the friction cone, the zero of which coincides with a pointer on the slide, when the gun is laid at "point blank."

#### *Slide.*

The slide is fitted with six trucks, those at the centre and rear being of the same radius. The trucks run on sweep plates, and the corner ones are fitted with suitable gear for traversing the slide, which revolves round a cast-iron pivot block.

An iron trough is fixed under the slide to receive a small two-wheeled truck which carries the projectile.



A loading chain for lifting the projectile is arranged to pass round sheaves fixed in the counterweight, and is worked from a barrel fixed on the right side of the slide.

Height...	{	to centre of gun firing position ...	ft.	in.
			14	0
Radii to centre of trucks	{	loading position...	6	11½
			11	10
Weight...	{	front ...	6	2
		centre ...	6	2
		rear ...	6	2
Weight...	{	carriage and counterweight ...	530	cwt.
		slide ...	272½	cwt.

### CARE AND PRESERVATION OF MOUNTINGS.

When mountings are not frequently used, the movable parts of the elevating and other gears will be removed and placed in store, where the bright parts of the iron work will be well coated with "Field's grease, No. 3," to preserve them from rust.

These parts will be thoroughly cleaned and placed in position, at least once in three months, to see that they are in proper working order. All gears should be worked once a week to ensure their being in a working condition.

If the paint is rubbed off any part of the mounting, the place should be patched over as soon as possible to prevent rust.

A thorough cleaning and lubricating of all standing working parts must take place once a month. In this cleaning, all clotted grease must be removed where visible, by scraping, and the parts wiped with an oily rag. Where mountings are much exposed and liable to accumulate dust or sand, they should not be left with much grease or oil upon them, but only sufficient to prevent rust, for which a very slight film will suffice.

Whenever and wherever fresh lubricant is applied, the old should first be wiped or scraped off, and the parts well worked to distribute the fresh lubricant before leaving them.

It has been found, especially in exposed positions, that a hard glassy cake of oil and sand, &c., will sometimes form between the carriage and slide, which is likely to escape observation, being of a semi-transparent nature, and which induces violent recoils from the very slippery surface it presents. Such a skin has to be hammered off; its formation is best guarded against by leaving as little oil on the sliding surfaces as possible when not in use.

When not in use, the position of the carriage and slide will be frequently changed to prevent impressions on the rollers, trucks, and racers, and to keep the sliding faces clear.

During practice, the top of the slide should be occasionally rubbed with a *slightly* oily cloth to prevent seizure.

Before firing or drill, care should be taken that all nuts and screws are properly tightened up; that all working parts are in proper gear, and that all friction cones are accurately adjusted and are not jammed.

Particular attention should be paid to the clip plates, the bolts of which tend to stretch and throw undue strain on the guide plates.

If a nut or screw be removed, it should be slightly oiled before being replaced, and a few turns given to it by hand before using the



spanner, to prevent damage by the threads crossing. A burr on the threads of a screw will prevent it being screwed home; a burr can be easily removed by means of a file. A hammer should never be used to tighten up screws or nuts.

Particular attention will be observed when removing or adjusting any gear not to indent or damage the component parts by rough usage; a hammer should never be used unless with a piece of wood or brass to transmit the blow.

Rollers and trucks will be removed and the axles properly cleaned and greased before replacing. The front trucks are removed by running the carriage back and lifting the front of the slide by hydraulic jacks sufficiently high to take the weight off the trucks; care will be taken to block up the slide before removing the axles. For the rear trucks, run the carriage up, place the jacks under the rear block plate, and proceed as for the front trucks. Particular care must be observed when replacing conical trucks that they are in correct position, viz., with the smallest diameter towards the pivot.

Racers should be scraped and cleaned and *well greased at the sides* where the truck flanges bite, to render traversing easy. The inner flanges of the trucks should also be cleaned and well greased. The *top* of the racers should be kept free from grease.

Care must be taken that the pivots of mountings do not cause the truck flanges to bear against the racers. Where an error in the position of pivot or pivot plate appears to exist, it should be at once reported.

The clamping arrangements or friction cones of elevating gear will be cleaned and *slightly* oiled to prevent seizing.

Jamming levers and friction cones of elevating gear will be tightened up by means of the adjusting nuts, so as to allow a slight slip in the gear on firing.

Iron-pointed levers and their sockets must never be oiled or greased, but simply cleaned to prevent rust.

In lubricating, the lubricating holes will be cleaned out with a wire and filled with oil, care being taken to replace the small screws, the heads of which must be *kept bright* so as to be readily seen.

A list of the oil holes in the mounting, stating their position and how access is obtained to them, is to be hung up in each emplacement, and none must be neglected. These lists can be obtained on demand, the nature of the mounting being specified.

After filling the oil holes, the parts should be worked backwards and forwards until the oil shows on the shafting, fresh applications of oil being made if necessary.

The teeth of all pinions and toothed wheels should be greased.

Hydraulic buffers should be carefully examined before firing or drill, to see that the cylinders contain the requisite quantity of fluid marked on the inscription plate, that there is no leakage at the glands, and that the piston rods are properly connected.

If a buffer leaks at the gland, and tightening up the latter does not stop the leak, the packing will be renewed.

The buffers will not be removed, but will be kept filled, and the piston rods will always be connected up, except in cases where guns are found to be especially hard to run back, and such guns are likely to be much used at drill, when officers commanding Royal Artillery may order the piston rods of such guns to be disconnected, provided such instructions be given as will ensure proper precautions being taken to prevent the gun taking charge in running up.

*To Fill the Buffer.*—Run the carriage up to the stops, take out the screw plug, and rest the gallon measure in the hole; turn off the cock and fill the measure to the mark, then turn the cock and allow the oil to run; repeat the operation until the required quantity is run in.

To renew the packing, run the carriage up, empty the buffer, unscrew the gland, and extract the defective packing. Tallow well the new packing, insert it in the stuffing box, and tighten it up with the gland.

Any drippings of oil from the buffer collected in the drip pans attached to the carriage or slide should on no account be used on any part of the machinery of the mounting, or any of the gun fittings.

The carriages and slides will be dismounted and the whole of the gear removed by ordnance artificers at the periodical painting, and all parts cleaned, keys adjusted, bolts and nuts tightened, lubricating holes thoroughly cleaned, the trunnion holes greased, and all parts properly lubricated, and any slight defect made good before re-assembling the parts.

Whenever any parts are found broken, defective, or deficient, which cannot be renewed by the artificer, fresh parts should be demanded at once. Any damage occurring at drill or practice should be at once reported, with a view to its being made good without delay.

In all correspondence and reports relating to carriages and slides, their exact natures, marks, and register numbers should be quoted.

#### *9-inch, High Angle, Mark I.*

If the recoil cylinders leak at the ram gland they must be tightened up; if this will not stop it the packing must be renewed or more added. The glands are packed with an L leather and hydraulic packing. The leather is intended to keep in the high pressure, but as it will not hold against low pressure while the pressure is being got up, the outer hydraulic packing is added. The outer packing is made deep enough to hold the high pressure in case of emergency until a new leather can be put in. If a new leather is to be put in, the recoil ram must be disconnected from the cradle. To do this it is necessary to have the gun nearly in the firing position, and to support it safely by skidding under the carriage. The pins connecting the ram to the cradle must then be taken out. When the ram is clear of the cradle the rings and old leather can be removed and a new leather put in. Great care should be taken in entering the leathers to see that the edge enters properly without being damaged. After replacing the glands and packings, open the raising valve gently, and the rams should then enter their sockets in the cradle where they must be secured by the pins. Remove the skidding supporting the gun and cradle, after taking the weight off them by letting the gun rise a trifle more.

The gland of the spindle of the raising valve can be repacked without blowing out the compressed air from the recoil cylinders as the screw thread is on the inside or below the packing. Before the gland nut and ring can be withdrawn to get the new packing in, it is necessary to take off the guide arc, and the valve lever disc from the spindle. In replacing the wheel and lever care must be taken to see that they are in the same position as before, or if the valve has worn

down so that the lever is at the end of its stroke before the valve is fairly shut, the disc may be advanced another hole.

The carriage is automatic in its action ascending into firing position immediately after firing. If the raising valve is closed the gun will remain in the down position after firing. If the gun is in the firing position, and it is desired to bring it down again without firing, the liquid must be run out of the cylinder, which will allow the gun to descend gently on to the buffers.

To charge the recoil cylinders, pump in about 12 gallons of liquid, but the exact amount is better regulated by the air cocks. The level is considered to be right when air saturated with vapour from the liquid comes from the upper air cocks when the gun is down, and from the liquid level cock when the gun is up. The air pressure required when the gun is down is 1,300 lb. per square inch.

The roller paths, teeth of traversing rack, underside of clip ring, and rollers, must be clean and free from all burrs.

#### *9-inch, High Angle, Mark II.*

All bright parts must be kept clean and slightly greased; all working parts must be properly lubricated, care being taken to replace the covering screws after lubrication.

The guides must be kept free from rust and well oiled; when not in use they must be well greased.

If the recoil cylinders leak at the glands, they must be tightened up; if this will not stop it the packing must be removed or more added.

To renew the packing, remove the upper stop of the elevating arc, lay the gun level, blow off the air pressure by opening the levelling cocks, and empty the cylinders by opening the drain cock; unscrew the glands, extract the defective packing and replace by the new.

If the adjusting arrangement for the recoil valves, the filling cocks or the air screws leak, they must be tightened up; if this is not sufficient the leathers must be renewed, to do this the pressure must be blown off.

To fill the cylinders with the gun up, lay the gun horizontal and block it in that position, slacken the levelling screws marked BB. Connect the pipe at valve marked A, open the valve A and pump in liquid (about 15½ gallons) till it overflows at the levelling screws BB, tighten up the levelling screws, disconnect the pipes at valve A, elevate the gun to 20 degrees and connect the pipes to the valve C, open the valve and pump in air until the gauge registers 450 lbs. per square inch, close the valve, disconnect the pipes, remove the blocks and replace the elevating stops.

#### *9-inch, High Angle, Mark III.*

The guides must be kept free from rust and well oiled; when not in use they must be well greased.

If the recoil cylinders leak at the ram glands, they must be tightened up; if at the rear cap, the cylinder must be tightened into the cap with spanner No. 123 Mark II. To renew the hydraulic packing at the ram gland, lay the gun level, blow off the air pressure by opening the levelling cocks, and empty the buffers by opening the drain cock, unscrew the glands, extract the defective packing and replace by the new.

To fill the buffers with the gun up and level, slacken the air screws marked AA at front of cylinder, and pump in about  $15\frac{1}{2}$  gallons of liquid at the filling cock C, closing the screws AA when the liquid flows from the openings. Pump in air until a pressure of 400 lbs. per square inch is obtained; close the filling cock C, and lay the gun at  $20^\circ$  elevation. Open the filling cock C, and the plugs B, pump in liquid until it overflows at BB, close BB and pump in air until a pressure of 465 lbs. per square inch is obtained.

The recoil valves (Plate XIIA) are for regulating the recoil of the gun, and great care must be taken on all occasions before firing, to see that they are properly set to the nominal lift of .2 inch. An index plate graduated in 10 divisions (each division equalling  $\frac{1}{10}$  of an inch lift) is fitted to the rear cap. A line is cut on the valve cover, which when the valve is closed points to zero on the index plate. To set the valve it must first be closed on its seating, and then turned two revolutions to "open," or .2 of an inch.

The recoil measured on the ram should not exceed 21.5 inches, for a full charge at extreme angles of elevation.

If the adjusting arrangement for the recoil plugs, the filling cocks, or the air screws leak, they must be tightened up; if this is not sufficient, the leathers of the filling cock and air screws, and the lead washer for the recoil plugs must be renewed; to do this the pressure must be blown off, and the liquid withdrawn.

The ball bearings must be lubricated with tallow, as oil will run away too quickly. When not in use the bearing screws should be removed and kept clean, and when in use they must be covered to prevent dust or grit getting in. When setting the gun on ball bearings the adjustment should be arranged, working the elevating hand wheel at the same time.

The roller paths (upper and lower), teeth of traversing rack, underside of clip ring, and rollers, should be quite clean and free from burrs.

*General directions for 9-inch, High Angle, Marks I, II, and III.*

The mountings should be kept thoroughly clean, and carefully examined every week. It is most important that grit and dust should be prevented from entering the cylinders.

After the last round of practice, a well oiled twist of tow should be bound tightly round the rams close to the gland of the cylinder, and left there until the next practice, when it should be carefully removed with the dust adhering. Any grit or dust found on the ram during the firing should be at once removed.

The efficiency of the mountings depends to a large extent on preserving the packing washers in good order. The cylinders should therefore be kept filled with the proper charge of liquid, and under the full working pressure.

Leakage of pressure is to be noted, and additional pressure pumped in, if necessary, at each weekly examination.

All spare leathers should be kept in store, and rubbed occasionally with dubbing to prevent their becoming hard and brittle. The supply of spare leathers should never be allowed to run low.

The axles of rollers, and the bearings of the shafts of the rest of the gear, will require periodical cleaning and lubricating, in the manner laid down on pages 19 and 20.

*Moncrieff Mountings.*

The retaining racks, teeth of bevelled wheels, pivot bolt, and the inside of the trunnion rings must be well lubricated.

The friction cones of the elevating gear must be kept clean, and not allowed to set; but on no account must they be greased. The cones are adjusted by tightening up the nuts on the end of the shaft; if too much slip occurs in action the nuts must be again screwed up and locked.

The brake drum must be kept free from rust and grease. The drum should be occasionally examined to see that the pawls and springs are in working order; the pawls should be lubricated by oiling the ends of the studs.

The tension of the brake bands must be sufficient to retain the gun in the loading position. The tension can be regulated by altering the position of the counterweight on the lever.



PROJECTILES.  
(Plates XIV to XVII.)

Nature.			Mark.	Bursting Charge.	Weight, filled, with gas-check.
Shell	common	studded .. ..	VI	lb. oz. 16 15	lb. 263
		stud- less.. { iron ..	I	17 0	256
		{ cast steel	II	27 12	256
		{ heavy ..	I (C.S.)	24 4	360
		{ .. ..	I	0 12	250
	Shrapnel	studded .. ..	II, III	1 5	256
		stud- less.. { iron ..	I	1 5	256
		{ cast steel	II	1 5	256
		studded (formerly shell) .. ..	III to VI	—	256
		studded .. ..	III to VII	—	256
Shot..	Palliser	studless .. ..	I, II, III	—	256
		" heavy* ..	I	—	360
		" .. ..	III	—	100
	case	iron .. ..	IV, V	—	107
		steel .. ..	I	—	256
	paper ( $\frac{1}{2}$ charge) .. ..		I, II	—	128

The bursting charges given above are P. and F.G. mixture for common shell and fine grain powder for Shrapnel. Common shell have hitherto been filled with L.G. powder, the bursting charges being considerably less than those given above.

All the above may be fired with full charges, except the studded Shrapnel, which are not strong enough to stand the full charge.

All the studded common and Palliser projectiles are fired for Mark II attached gas-checks. The studded Shrapnel are fired without a gas-check.

All the studless projectiles (including Shrapnel) are fired with automatic gas-checks.

The heavy projectiles (360 lbs.) are for the guns on high angle mountings.

Iron case shot are usually fired two at a time, as a single one does not give sufficient recoil.

Steel case shot are intended for the defence of narrow channels, not exceeding 600 yards in width, against torpedo boats.

Paper shot are for use at Station Practice where there is not a clear range. The cylinder breaks up on firing, and the small shot with which it is filled only travel a short distance (about 200 yards) whilst the effect for purposes of testing recoil, &c., is practically the same as that with a service projectile.

Palliser projectiles were formerly divided into shot and shell; the latter have been abolished, as such, and are now weighted up with sand to bring them up to the same weight as the shot. They are designated "Palliser shot," with the same numeral as the corresponding mark of shot.

\* No more of these will be made. As they are used up they will be replaced by the heavy common shell.

## DESCRIPTION.

## Common.

*Studded.*—The Mark VI shell is of cast-iron, cast with bands it is about 3 calibres long, and the head is struck with a radius of  $1\frac{1}{2}$  diameters. The point is fitted with a gun-metal bush, tapped to G.S. fuze-hole gauge. There are 2 extractor holes in the head. Two rows of studs, of an alloy of 10 parts of copper to 1 of tin, are pressed into undercut holes, cut into the body of the shell. There is a hole in the base which is tapped with a screw thread for the reception of the gas-check plug. The interior of the shell is lacquered. It is filled through the head, the bursting charge being contained in a dowlas bag. Mark II rotating gas-check is used with this shell.

Marks I to V were not fitted for gas-checks and are ordered to be broken up.

*Studless.*—The Mark I differs from the above in having the head struck with a radius of 2 diameters, in not having any studs, and in having the base cast with a locking rim for the attachment of the automatic gas-check. It is filled through the base.

Mark II is of cast steel. In general construction it resembles the Mark I shell, but the material being stronger, the walls are thinner and longer, the capacity for the bursting charge being increased in proportion.

The heavy shell is also of C.S. but differs from Mark II in having a solid pointed head and weighing 360 lb. It is fired from the guns on H.A. fire mountings only.

## Shrapnel.

*Studded.*—The body of the shell is of cast-iron, without bands. The walls are about the same thickness as those of the common shell. Near the base they are thickened, so as to form a shoulder on which rests the diaphragm of wrought-iron. This has a hole in the centre into which is screwed a piece of gas-pipe. Below the diaphragm is a tin cup to contain the bursting charge, coned at the top to facilitate unloading, and terminating in a neck which fits into the gas-pipe. The use of this cup is to guard against possible pre-matures from the roughness of the interior of the shell, and to prevent loss of powder. The interior of the shell above the diaphragm is lined with brown paper and filled with 2-oz. sand shot packed in rosin, the whole being covered over by a felt washer. The head of the shell is a thin cup of Bessemer metal fitting over a block of wood, hollowed out in the centre for the reception of the fuze socket, which is of gun-metal, countersunk, and fitting at its lower end into the central iron pipe; it is tapped inside with a screw thread, at the top to the G.S. fuze-hole gauge, and at the bottom for the reception of the "primer, Shrapnel shell." The Bessemer metal of the head fits into a groove round the top of the cast-iron body, and it is held in position by two rows of rivets, but as the upper row are only intended to keep the head from twisting off in flight, they are called "twisting pins," and to keep them from forming too strong an attachment the metal of the body is slotted out to the edge, so as to



oppose no resistance to a blow from the rear. A band of solder round the junction of the body and head keeps these rivets and twisting pins from falling out. There are 2 extractor holes in the head, which are lined with tin to exclude damp.

The above is a description of the Mark III shell. The Mark II differs only in not having the fuze-hole socket countersunk.

Mark I was weaker, had a smaller central tube, and a thinner diaphragm which was not coned underneath.

Mark I contains 564—2 oz. sand shot, Marks II and III, 374.

None of these shells are fitted for gas-checks.

*Studless.*—The studless shell, Mark I, is of iron cast with bands. Its interior arrangements are similar to those of the studded shell. The gun-metal socket is flanged over the Bessemer metal head. The head is attached by 2 rows of rivets as in the studded Shrapnel, but the head is slotted instead of the body, so that the twisting pins are the lower row. The interior of the shell is slightly larger at the mouth than at the base, with the object of facilitating the dispersion of the bullets; and to assist in breaking up the shell there are 6 longitudinal weakening grooves in the body and in the powder chamber.

The base is fitted for the automatic gas-check.

Mark II is of cast steel, similar in construction to Mark I, but with thinner walls and consequently containing a larger number of sand shot. The diaphragm is of steel, and there are no weakening grooves.

Mark I contains 292—2 oz. sand shot, Mark II, 532.

There is no Shrapnel shell for the guns on High Angle mountings.

### Palliser.

*Studded.*—These are cast head downwards, the mould for the body being of sand, that for the head being a block of iron called a "chill." This makes the head intensely hard and the body comparatively soft.

The head is pointed, struck with a radius of  $1\frac{1}{2}$  calibres.

Only the latest Mark is cast with bands.

A soft iron bush is cast into the base and tapped with a screw thread to take the base plug or gas-check plug. The joint between the bush and the base of the shell is sealed by a lead ring hammered into an undercut groove.

Of the earlier patterns, Marks I and II had the bodies cast in chill and are ordered to be broken up; Mark III had a blunter point, the head being struck with a radius of  $1\frac{1}{4}$  calibres instead of  $1\frac{1}{2}$ . Marks III, IV, and V were not originally intended for gas-checks, but have since been altered to take them, III and IV shot taking a different plug to III and IV shell.

The different Marks vary in weight, size, and shape of interior cavity, and method of closing the base.

Those formerly termed "shell" have their bursting charge replaced by sand in order to bring them up to weight and have a W painted on the head, and stamped on the base plug. They were formerly distinguished from the shot by having their tips painted white.

*Studless.*—These shell are cast with bands and have the head struck with a radius of 2 diameters. They are provided with the



same bush as the studded projectiles, but as the base is covered by the automatic gas-check the lead ring round it is unnecessary and is therefore omitted.

Mark I was cast in one piece, but as it was found that the locking rim round the base was very apt to get chipped and broken, Mark II was introduced, cast without the base disc, which was made separately of wrought iron or steel, and attached by a conical headed gun-metal plug. (See Plate XV.) In Mark III, however, this detached base disc is done away with, the projectile being cast all in one piece, and the base closed by a soft cast-iron disc, firmly secured in its place by being run in with molten lead. The interior cavity is smaller and of a different form to that of the previous patterns. (Plate XVI.)

The heavy shot is for guns on High Angle mountings only. It is similar in construction to the Mark III, but is a good deal longer and weighs 360 lbs. (See Plate XVII.) No more of these heavy shot will be made. They will be used up at practice, and will be replaced by the heavy common shell.

### Case.

Iron case shot are made of tinned iron in one piece, riveted longitudinally, and fringed at both ends. The bottom fringe is bent over and riveted to the sheet-iron bottom, and when the case is filled the upper fringe is bent over and soldered to the tinned iron top. It has 2 handles attached to iron staples, which are bent round to form a loop and riveted to the inside of the head.

In the interior of the cylinder is a wrought-iron disc lying loosely on the bottom, and on this stand 3 wrought-iron segments forming a lining to the case; the contents are 8-oz. sand shot, 113 in number, packed in clay and sand.

In Mark IV the handles were not so firmly attached; in Mark III the shot were packed in coal dust.

Marks I and II are obsolete.

Steel case shot are similar in general construction to those filled with iron shot, but differ in dimensions, weight, and contents, and in having iron lifting rings instead of handles. They are filled with steel shot ( $3\frac{1}{2}$  lbs. each), and have the words "filled steel shot" stamped on the top, and a white band 1 inch broad painted round the body.

The total length is 23.55 inches.

### Paper Shot.

These are made up in  $\frac{1}{2}$  charges weighing 128 lb. each, when filled. Mark II consists of a cylinder of "papier-mâché," with a hard, black polished surface, closed at each end by a ribbed disc of the same material. The top disc has a hole in the centre through which the shot is filled with a mixture of sawdust and "waste" shot, Nos. 1 to 5, in such proportions as to bring it up to the required weight; the hole is then closed by a cork plug.

Mark I consisted of a cylinder of brown paper, choked at top and bottom to wooden discs, and filled in the same manner.

## INSTRUCTIONS FOR THE PREPARATION OF SHELLS.

## Fixing Gas-Checks.

*Studded Projectiles, with Plug and Nut.*

Unscrew and remove the nut with the "spanner gas-check nut," then apply the "wrench, base-plugs" to the gas-check plug, and screw it well up in the direction of the arrow\* to ensure its being well home.

If, when unscrewing the nut, there is any tendency for the plug to unscrew also, the "wrench, base plug," should be at once applied to the head of the plug and turned in the direction of the arrow, at the same time as the nut is being turned in the opposite direction.

Place the gas-check on the base of the projectile with the concave, or unpainted side, next the base, then screw the nut on to the end of the plug with the "spanner, gas-check nut." The nut must be screwed down to the shoulder on the plug.

*Studless Projectiles with Automatic Gas-Checks.*

These gas-checks become fixed to the projectile when the gun is fired. They are loaded separately, except when firing  $\frac{1}{4}$  charges from guns on High Angle mountings, when they must be nicked on to the projectiles before loading, as the force of the powder is not sufficient to attach them securely.

An automatic gas-check will be issued for all guns for which they are authorised for drill purposes. It must be firmly nicked on the shell, as otherwise it cannot be extracted. Care must be taken—

- (a.) That the gas-check is not injured, and that it is at all times free from burrs.
- (b.) That the drill cartridge is sufficiently long to prevent the gas-check from jamming in the end of the grooves.

## Filling Shell.

For full details of the classes of powder that may be used for filling shells, see Magazine Regulations.

Generally speaking, they are as follows:—

For common shells the bursting charge is of P and F.G. mixture, which is composed of P. or Q.F.<sup>1</sup> and a fine grained powder, viz.:—Pistol, F.G., R.F.G. or R.F.G.<sup>2</sup> If none of the latter are available L.G. may be used in cases of emergency.

Shrapnel shells are to be filled with Service R.F.G.<sup>2</sup>, R.F.G., F.G. or Pistol powder; powder reduced in class to "shell" is not to be used.

\* The heads of the gas-check plugs, and the wrought-iron nuts, are each stamped with an arrow to show the direction in which to turn, either when screwing on the gas-check plug, or when screwing on the wrought-iron nut.

*Common, Studded.*

Remove the plug from the fuze-hole, place the filling-rod in the bag, insert it through the fuze-hole, taking care not to force the end of the rod through the bottom of the bag; carefully push in the bag until the neck only is in the fuze-hole, a portion being kept outside, as the whole bag must not be allowed to slip into the shell during the operation of filling: then withdraw the rod.

Weigh out the bursting charge in proportions of about 4 lb. P. and 10 oz. F.G.

Drop in one portion of P. powder, pebble by pebble, then insert the funnel and pour in one portion of F.G. Then insert the filling rod, and lightly press and stir the powder all over, so as to set it well down into the shell.

Repeat the operation till the shell is completely filled.

Withdraw the funnel and filling-rod and tie the neck of the bag with twine close to the top of the fuze-hole. A piece of twine is attached to the neck of the bag for this purpose; it must be shifted to its proper position if necessary. Cut off the superfluous choke and push the neck of the bag well down, and to one side of the fuze-hole; insert two "Bags, primer, filled, 7 drams," or more, if there is room; then screw in the fuze or plug as required, taking care that the fuze-hole is clean, and the fuze or plug lubricated.

*Common, Studless.*

These shells are filled from the base. Place the shell upon its point, which may be inserted in a block of wood hollowed out for the purpose or in any other convenient place. If the shell immediately after filling is to be used with a wood time fuze, insert an unserviceable M.L. wood time fuze, or a piece of wood of the same size in the fuze-hole before filling, if not, the fuze-hole plug will be sufficient.

After standing the shell upon its point, pass the "Holder, shell, studless, 9 inch," over the base and screw up the bolt, then hold the handles firmly while another man unscrews the base plug with the "Wrench, base plug." Now drop in three "Bags, primer, filled, 7 drams." Place the brass filling-rod inside the bag and insert it in the shell, taking care not to push the rod through the bag, withdraw the rod, and complete the filling as above for "studded," but of course no "bags, primer" are to be inserted after filling.

*Shrapnel, Studded or Studless.*

Remove the plug from the fuze-hole, and, after seeing that the latter is clear of any dirt, &c., insert the leather funnel and pour in the bursting-charge, which has been previously weighed. This must be done gradually, for if the whole of the powder is put in at once the tube will probably become choked. The shell should be tapped on its side with a wooden mallet until the whole of the bursting-charge has passed down the tube, taking care that none of the powder is left at the bottom of the socket. Drop in the "Primer, Shrapnel shell," and, by means of the "Driver, screw, Shrapnel, large," screw it tightly into the tube, and then screw in the fuze or plug as may be required. If the primer is too tightly screwed home it is liable to jam so that it cannot be unscrewed.

### Fixing Plugs and Fuzes, and Securing Shells.

When plugs or metal fuzes are screwed into shells they will be lubricated with a mixture composed as follows :—

Linting, Mark II ..	..	..	100 parts, by weight.
$\frac{1}{2}$ rape oil	}	..	17 „ „
$\frac{1}{2}$ lubricating oil			

A coat of paint of the same colour as the tip of the shell is to be applied over the junction of the G.S. fuze-hole plug and shell when the latter is filled.

Empty projectiles fitted with plugs and kept in exposed situations where the plugs are liable to become set fast by corrosion from the action of salt water, or otherwise, should have them unscrewed once at least every six months, and the threads cleaned and re-lubricated as above, a coat of paint being applied if the shell is filled.

Instances have occurred in which fuze-hole plugs of common shells have been so jammed in as to be immovable, in consequence of using the "Wrench, base plug." The "Key, fuze, and plug, G.S.," or the "Key, plug, G.S.," or the "Key, fuze, universal," are the only implements which should be used for screwing in the G.S. plug.

### Distinguishing Marks.

Shrapnel shell will be painted with a red tip 1 inch deep.

Steel projectiles will have a white band  $\frac{1}{2}$  inch wide painted round the head 1 inch from the top: in the case of Shrapnel this white band will be immediately below the red tip. C.S. will be stamped on the base of cast steel, and F.S. on the base of forged steel projectiles.

All filled shell will be marked in red, as follows, the size of the type being  $\frac{3}{4}$  inch :—

- (a.) A band  $\frac{1}{2}$  inch wide round the head,  $1\frac{1}{2}$  inches from the top; this will be  $\frac{1}{2}$  inch below the red tip of Shrapnel shell, or immediately below the white band of steel shell.
- (b.) The word "bag" if one has been used.
- (c.) The monogram of the station except when filled by R.A.
- (d.) The date of filling.
- (e.) A disc 1 inch in diameter if shalloon primers have been inserted.
- (f.) The letter P,  $1\frac{1}{2}$  inch long, if filled with P. and F.G.

Palliser shot (formerly shell) which have been weighted up with sand will have the letter W stencilled in white on the head, and also stamped on the base plug.

Projectiles which are to be used for practice only will be marked with a yellow band  $\frac{1}{2}$  inch wide round the body, any other markings, except red or white ring, or red tip, being obliterated.

Shells which have been emptied will be marked on the head with the letter E in red paint, and also the monogram of the station.

### Examination of Filled Shells.

The examination of filled shells will only be carried out by an Inspector of Warlike Stores. The general procedure is as follows:—

#### *Common.*

Remove the fuze-hole plug, and withdraw the "bags, primer," with the "hook, G.S. wads." With studless shell remove the base plug by means of the "wrench, base plug." Untie the twine round the neck of the bag. If the powder is in a serviceable condition, tie up the neck of the bag again, and proceed as directed in the instructions for filling, previously adding additional powder within the bag, if necessary, to fill the shell. If the powder is found to be caked from the effects of damp, the shell should be returned into store.

#### *Shrapnel.*

Remove the fuze-hole plug, and note specially whether any powder has worked up into the socket, unscrew the primer with the "Driver, screw, Shrapnel, large," and lift out the primer with the "Pincers, Shrapnel primer;" turn the shell nose downwards, and allow a portion of the powder to run out; if the powder charge flows out freely, return it, insert a new primer, and replace the plug. The old primer will be tested. The shell should be well shaken if the powder does not come out quite freely, as a portion of the powder may possibly be jammed in the tube; if the powder cannot be extracted as above, the primer and plug should be replaced, and the shell returned into store.

If the primer cannot be extracted, the shell will be plugged with wood and will have a yellow band, denoting practice, painted round the body, all other markings being obliterated, except the red ring and tip, and white ring, if present.

### Storage of Filled Shells.

Filled studded shells in charge of the Royal Artillery will have the gas-checks attached to them before being placed in the shell store.

The shells are to be placed on their bases, resting on the gas-check plugs, and being prevented from falling over by two pieces of wood, 9" x 1" square, placed one on each side of the nut.

Shells taking automatic gas-checks will be stored unfitted on their bases.

### Wedge Wads.

These consist of two wood wedges 7 inches long, connected by a piece of cane 7.5 inches long. They are rammed home after the projectile to prevent it slipping forward when the gun is run up.

An extractor is not to be used to unload a gun whilst a wedge wad remains rammed home. If the wad cannot be removed by means of a wad hook, the charge must be fired.

## Gas-Checks.

The Mark II rotating gas-check is used with common and Palliser studded projectiles, to which it is attached by means of a plug and nut (see Plate XIV). It has projections round the edge which fit into the grooves of the gun. A shoulder on the plug prevents the nut from being screwed home against the gas-check; consequently the latter has a small amount of play and is free to rotate round the plug, which is necessary in a gun with an increasing twist of rifling in order to prevent the gas-check from jamming. Studded Shrapnel are not fitted for gas-checks.

The automatic gas-check is used with all studless projectiles, including Shrapnel. It not only seals the escape of gas but also imparts rotation to the projectile. (Plate XV.)

There are two patterns of automatic gas-checks; the "Gas-check, R.M.L., 9-inch, automatic," with 6 projections, for Marks I to V guns, and the "Gas-check, R.M.L., 9-inch, polygroove," with 27 projections, for the polygroove guns.

The weight of the former is 9lb.; that of the latter, 9lb. 3oz.

## FUZES.

(Plates XVIII to XXI.)

Percussion { Pettman G.S., No. 5, Mark II.  
 Direct action, No. 3, Marks I\* and II for land  
 fronts; Mark III for sea fronts.

Time { 15 seconds, with detonator, No. 43, Mark III.  
 Sensitive, middle No. 24, Mark I.

The Pettman fuze is for use with full charge and studless shell only.

15 seconds M.L. No. 41 may be used in shells not fitted for gas-checks, *i.e.*, studded Shrapnel.

*Pettman G.S. Fuze. (Plate XVIII.)*

The fuze consists of the following parts:—

Body (A), top plug (B), plain ball (C), steady plug (D), detonating ball (E), cone plug (F), lead cup (G), and suspending wire (H).

The body and top plug are made of gun-metal; the cone plug, detonating ball, and steady plug are also made of gun-metal, but of a harder alloy to prevent them from altering their shape; the plain ball is of brass, and the suspending wire of copper.

The plain ball is held in position by a cup in the steady plug; round the latter there is a ring of composition covered by a thin, lacquered copper washer. Through the steady plug are two fireholes to convey the flash from the ring of composition to the interior of the fuze. The detonating ball is milled and grooved, and covered with detonating composition, which is protected by one thickness of gut and two of silk, over which are two copper hemispheres, covered again by one thickness of gut and three of silk. The cone plug is pierced with three fireholes, of which the central one is driven with mealed powder and pierced like a tube. The suspending wire passes through the cone plug. The lead cup is a hollow cylinder, having a flange on the top to fit into a recess on the cone plug when it is crushed.

When fired, the steady plug, ball, and cone plug set back on the shock of firing, the suspending wire is broken, the lead cup prevents rebound, and the stem of the cone plug protrudes through the base of the fuze, the detonating ball being released from its pivots by the slight unsteadiness of the shell in flight; on striking, the ball is dashed violently against the side of the body, explodes the detonating composition, and fires the shell, the flash passing through the holes in the cone plug to the priming, and thence to the bursting charge.

When fired with a projectile fitted with a gas-check, the steady plug may not disengage, owing to the steadiness of flight of these shells, and in this case the detonating ball will not act. The plain ball is released by the steady plug setting back, and is caused by the centrifugal force to spin round the circumference of the body over the ring of detonating composition. On striking, the ring is dashed against the plain ball, and detonates, exploding the shell through the fireholes.



The fuze acts only on impact, not on graze; it is to be used with full charges only.

The manufacture of this fuze has been stopped; it is replaced by the Direct Action.

*Direct Action. (Plate XIX.)*

The Mark II fuze consists of the following parts, viz., body, cap, screw plug for needle disc, needle disc, screw collar, bottom screw plug, steel needle.

It is made of an alloy resembling gun-metal, with the exception of the steel needle, copper disc, and a few minor portions.

The *body* is tapped on the exterior to the general-service taper and pitch. The lower part is hollowed out to receive a blowing charge of fine powder (75 grains). The bottom is closed by the bottom plug screwed in, as shown in the cut. The upper portion of the body is turned to receive the cap, and is bored out to receive the screw plug for needle disc and screw collar. It is recessed to receive the detonating composition. At the bottom of this recess nine conical fire-holes are bored through the metal separating the upper and lower portions of the interior of the body. A small brass pin is screwed into each side of the body on the exterior, near the top.

The *screw plug for needle disc* is tapped so as to screw into the body, and is recessed. It is slightly coned at the bottom, and has a hole through the centre  $\frac{3}{16}$ " in diameter. Two holes are drilled in the top so as to screw the plug into the fuze. Its upper portion is recessed to hold the needle disc.

The *screw collar* screws into the body over the screw plug, and has slots cut in its upper edges for the purpose.

The *needle disc* is of copper,  $\frac{1}{32}$ " thick, and has a central hole to receive the needle.

The *needle* is of steel, and of the shape shown in the section, having four points. It is sprung into the disc.

The *cap* fits over the top and has a milled edge. On each side a T-shaped slot is cut to fit over the brass pins in the body, and thus to secure the cap to the fuze. A square keyhole is cast in the upper surface, so as to take the G.S. plug and fuze key.

The *bottom plug* is screwed into the bottom. It has a central hole, and two key holes for screwing it in. It is secured and rendered damp-proof by cement and solder.

The conical holes are filled with meal powder paste, and are covered on the under side with a disc of fine white paper shellaced on.

Three grains of cap composition are pressed by a 600 lbs. pressure into the recess provided for it. It is varnished, and covered with a disc of varnished paper, on the top of which is a copper washer kept in position by being span over.

A disc of red shalloon and one of white paper are attached by shellac varnish to the bottom plug.

The fuze, being prepared by simply taking the cap off, is quiescent in all its parts till direct impact takes place, or a graze at such an angle that the nose of the shell enters the ground. When either of these events occurs the needle is crushed down on to the detonating composition, which fires, and ignites the meal powder in the conical



holes and the fine grain powder. The flash therefrom blows down into the shell and fires the charge.

The head of the needle being some distance below the head of the fuze, it cannot be touched or forced down on the detonating composition when any ordinary rammer is used for loading.

Mark I\* is almost identical, being the Mark I fuze, which is obsolete, converted to Mark II pattern. The Mark III differs from it in being slightly longer, the screw thread continued to the top to enable the fuze to be screwed in flush with the top of the shell, and in the fuze being closed with a safety plug with left-handed screw in place of the cap.

*15 secs. Time Fuze with Detonator. (Plate XX.)*

This fuze is made of beech. It is bored with a central composition hole and six powder channels. The powder channels communicate one with another by means of a strand of quickmatch pressed into a groove on the base. The fuze composition is pressed into the central hole. The fuze is ignited on discharge by the setting back of the hammer on to a detonating pellet. The hammer is retained by a suspending wire 0.03 inch thick, and by a safety pin which is withdrawn before ramming home. The fuze is marked spirally from 1 to 30, the figures and dots being arranged in six columns corresponding to the powder channels.

Time of burning at rest, 14.6 to 16.5 seconds.

*Sensitive, Middle (Plate XXI.)*

The fuze consists of the following parts:—

Body (a) with stem, lighting pellet (b), two retaining bolts (cc), two spiral springs (dd), needle (e), composition ring (f), dome (g), cap (h), two safety pins (ii), base plug (k), and axial magazine filled with M.G. powder (l).

All the parts are made of gun metal.

The composition ring is graduated on its periphery from 0 to 30, and reads to quarter units. An  $\Psi$  is stamped on the ring to show the safety point, and when this coincides with the  $\Lambda$  on the body, the fuze is set at safety. The cap which screws on to the top of the pillar is made hexagonal, to fit the "Key, fuze, universal."

The fuze is set, after being fixed in the shell, by loosening the screw cap (h) on the top of the stem, by means of the "Key, fuze, universal," and turning the dome and ring till the required graduation on the collar coincides with the arrow head on the body, and then tightening the screw cap. The safety pins are withdrawn at the moment of loading. On discharge, the centrifugal action causes the remaining pellets to fly out, releasing the lighting pellet, which flies out by centrifugal force against the needle, firing the detonator, which ignites the powder in the pellet and axial magazine, this latter lighting the quickmatch in the composition ring.

Weight, 1 lb. 4 oz.

Time of burning at rest, 14.6 to 15.8 seconds.

## Preparing Fuzes.

*15 seconds, with Detonator.*

This fuze is prepared for any desired time of flight by boring through the side hole corresponding to the required time, into the composition.

When using the hook-borer, place the fuze in the hook of the hook-borer in the proper position for boring the required hole; enter the bit into the side hole, screwing up until the bit has entered as far as the borer will allow, taking care to press the fuze with the fingers so as to ensure its bedding fairly in the hook.

Unscrew, and when the bit is quite clear, remove the fuze from the hook. The length of the bit is so regulated that, when placed in the handle, it will enter sufficiently far into the composition when screwed down to the shoulder. If the bit should become unserviceable, the handle must be detached from the shank and the tightening-screw unscrewed, the square hole in the hook being made for that purpose. Care must be taken when substituting another bit that it is properly placed in the handle, and that the tightening-screw firmly presses upon it, for if any space be left between the handle and the head of the bit, the end will not enter a sufficient depth into the composition. The borer should be occasionally examined and cleaned. The operation of preparing the fuze and fixing it in the shell takes, on an average, about 15 seconds; with a little practice these operations may be performed in a shorter time.

## Fixing Fuzes.

*Direct Action.*

This fuze requires no preparation except the removal of the metal cap of Marks I\* and II or plug of Mark III. It is screwed firmly into the fuze-hole by means of the "Key, plug, G.S.," or the "Key, fuze, universal." The cap or plug must not be removed until after entering the shell into the muzzle of the gun.

*Pettman, G.S.*

This fuze requires no preparation; it is simply screwed firmly into the fuze-hole by means of the "Key, plug, G.S.," or "Key, fuze, universal."

*15 seconds, with Detonator.*

This fuze should be screwed into the fuze hole by hand; when it cannot be screwed any further it is properly secured. It must not be fixed by striking it with a mallet or any other instrument, neither must it be struck against anything.

The safety pin must not be withdrawn until after entering the shell into the muzzle.

*Sensitive, Middle.*

This fuze should be screwed into the fuze-hole by hand, as far as possible, and then tightened up by inserting one of the points on the circular arm of the "Key, fuze, universal," in the small hole in the circumference of the body of the fuze.

## CHARGES.

Mark of Gun.	Charge in Lbs.	—
I to V .. ..	Full ..... 50	In one 50-lb. cartridge, or two 25-lb. "
	Reduced ..... 33	In one 33-lb. "
VIA, VIB, VIC.. ..	50, 37½, 25, 12½	In 4, 3, 2, or 1 cartridges of 12½ lbs.

All the above are of P. powder.

There is also a saluting charge of 20 lbs. blank L.G. powder.

The four charges given above for the high-angle fire guns are the only ones at present approved, but a fifth is under consideration intermediate between the 12½ lb. and the 25 lb. charges.

The 12½ lb. cartridge is to be used with high-angle fire guns only, on account of the inconvenience of loading the ordinary 9-inch guns with quarter charges.

All new cartridges are made of silk cloth, hooped with silk braid. Some of the old serge cartridges may, however, still be met with; they are choked with worsted and hooped with blue worsted braid. They will be used up as far as possible before the silk cloth, except when firing blank, in which case silk cloth cartridges are *always* to be used.

### Directions for Making up Cartridges.

Care will be taken to see that the empty cartridges are properly dry before being filled. The proper charge will be carefully weighed out and inserted in the cartridge by means of the "Funnel, copper, cartridge." The cartridges will be choked by drawing together the mouth of the cartridge into several pleats with a magazine needle threaded with three strands of silk twist. After drawing together the mouth of the cartridge, the choke will be temporarily secured, the becket drawn tightly in on both sides, three turns will be taken round the plaits and becket, and the choke thus formed will be further secured by passing the needle five times through it, alternately above and below the turns, thereby stitching down the turns round the choke at four points equidistant from each other; the becket should form a loop about 3½ inches in length.

The 25 lb. and 12½ lb. cartridges having no becket attached require three strands of silk twist passed round the pleats three times, and the needle passed through the choke four times, making three securing stitches.

The cartridges will be made up to their proper lengths and diameters by means of the hoops, which should be drawn tight, so as to make a firm cartridge. To do this:—

Draw the braid through the silk cloth until the knot of the loop comes home to the cartridge; the single end being passed through the loop from underneath, pass the single end to one side of and

under the loop, then draw the hoop tight and keep it so by placing the forefinger of the left hand firmly on the loop; bring the running end between itself and the loop, and draw tight the single bend thus formed, *taking care that the bend bites on the loop and not on the single end*, otherwise the knot will slip. The maintenance of the proper form of the cartridge depends on the hooping being thus secured.

Cartridges, after being choked and hooped, will have the ends of the choke cut off to a convenient length, which should in no case exceed half the diameter of the cartridge; the superfluous ends of the hoops will also be cut off. They will be very carefully examined and gauged as to length and diameter previous to packing. The dimensions are as follows:—

Length of 50-lb. cartridge not to exceed 23.5 inches.				
"	33	"	"	18.0 "
"	25	"	"	11.75 "
"	12½	"	"	7.5 "
"	Blank	"	"	8.25 "
Diameter of all cartridges				8.5 "

### Marking Filled Cartridges.

All cartridges issued from store, when filled, will have the initial or monogram of the station at which they are filled stamped on the bottom end, and the nature and weight of powder which they contain marked on the side in black printers' ink, the letters being 1 inch long. About ¼ oz. of ink will be sufficient for 100 cartridges.

The cartridges filled by the Royal Artillery will be distinguished by having no initial letter stamped on them. *This is not to apply to cartridges filled by working parties of the Royal Artillery or the Ordnance Store Department.*



### Packing and Storing.

The cartridges may be packed as follows:—

50-lb. cartridges	..	..	1 in a 50-lb. cylinder.
33	"	..	1 " 33 " " or
25	"	..	2 " 50 " " or
	"	..	1 " 25 " " or
	"	..	2 " 33 " " or
12½	"	..	8 " whole metal lined
	"	..	case, if cylinders are not
	"	..	available.

To close the cylinders, screw on the lid by hand from left to right, and tighten up by means of the bearer until the washer bears hard upon the top edges of the cylinder. Apply a coat of gum shellac, dissolved in sufficient methylated spirits to be of a workable consistency, to the junction of the body and lid; then fasten round the junction a tape band 2½ inches wide, well coated with shellac cement. The tape should overlap about 4 inches, and be placed so that the edges may be protected as much as possible by being in the hollows of the corrugations; work the tape (except the end which

is turned under, forming a loop 1 inch in length) well into the corrugations with the hand, and, when well set, give the band a coating of thin shellac cement.

In order to open the cylinder tear off the tape band, and pass the cylinder bearer through the handles, and then give a smart wrench in the required direction.

Labels bearing the above directions are pasted on the lids of each cylinder.

Where storage accommodation permits, cartridge cylinders will be stacked vertically in columnar form (*i.e.*, one immediately above the other), each column not to exceed three 50-lb. or 33-lb. cylinders, or four 25-lb. cylinders.

Where the chambers are sufficiently lofty to admit of more than one stack, the second stack will be placed on skidding supported by frames.

Care should be taken that the cylinders do not touch the walls when stacked. Thin battens of wood will be placed under the bottom cylinders when the floor is of stone or concrete.

Where cylinders cannot be stored vertically, they will be piled on their sides, and the number of tiers in each stack will be limited to five.

### Drill Cartridges.

Drill cartridges are a special manufacture and issued complete. They are of wood covered with raw hide.

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### TUBES.

- Tube, Friction, Copper, Long, Mark II.
- " " " Solid-Drawn, Mark II.
- " Electric, No. 10, Mark IV.
- " Vent-sealing, Electric, P, Mark V.

Mark I to V guns are fired by friction tubes, either "Long" or "Solid-drawn," except when they are in connection with a Position Finder, when No. 10 Electric tubes are used. The vent-sealing electric P tubes are for guns on High Angle mountings, which are fitted with a special steel vent for vent-sealing tubes, and having no percussion lock, cannot be fired except by electricity.

The *Tube, friction, copper, long, Mark II*, consists of a copper tube, 5 inches long and 0.2 inch in diameter, lacquered inside, driven with mealed powder, and pierced with a central hole. The top is closed with shellac putty and varnished paper, and the bottom by a disc of varnished paper. A hole is bored through one side of the tube, having its centre about 0.25 inch below the top, and over this hole is secured a copper nib-piece, containing a roughened copper friction bar. This is smeared with a detonating composition of chlorate of potash, sulphur, and sulphide of antimony, and the nib-piece is pinched down upon the friction bar, the projecting part of which has a vertical eye, into which the hook of the lanyard fits. On pulling the lanyard the friction bar is drawn out, igniting the com-

position, and firing the tube; the central hole gives a passage for the flash, and causes instantaneous action. The gas from the exploded cartridge drives the tube out of the vent.

They are packed 25 in a tin cylinder.

The *Tube, friction, copper, solid drawn, Mark II* (Plate XVIII) is made of solid drawn copper, and has a solid head; it is filled with pistol powder, and the bottom is closed by a brass ball over which is a cork plug, secured by shellac. The length is 2.1 inches. The arrangement of the friction bar is similar to that of the long copper friction tube described above, except that the nib-piece is solid drawn and projects right through the tube, and has a small hole bored in it to allow the flash from the friction composition to reach the powder in the tube.

Mark I tube had not the brass ball, and the nib-piece was similar to that of the long tube.

They are packed 25 in a tin cylinder.

*Tube, electric, No. 10, Mark III.*—This tube is made up from three quills cemented together. The two lower ones are filled with mealed powder, as in copper tubes; the upper quill contains an ebonite plug about 1 inch long, in which two longitudinal grooves are cut to take the bare ends of the terminals of the leads. The ends of the wires are joined by the naval bridge, which is surrounded by the priming composition of gun-cotton dust and mealed powder, packed closely into the cavity between the ebonite plug and the mealed powder in the lower tube. On the top of the powder in the lower tube is a small wad of gun-cotton to prevent the priming falling away into the central hole of the tube and leaving the bridge bare.

To prevent the tube being inserted too far into the vent a frapping of thread is made on the wires about 1 inch from the top quill.

The upper end of each wire terminates in a spiral .6 inch long for joining to the leads from the battery. The spirals are coated with tin and covered with oiled silk, secured by shellac varnish. The tube is varnished with shellac.

Mark IV differs from the above in having its wires and poles coated with tin, and in having its bridge attached with that metal instead of solder.

They are packed 25 in a tin cylinder.

The *Tube, vent-sealing, electric, P, Mark V* (Plate XXII) is made of brass, bored out to receive the arrangement for firing by electricity, and coned at the top of the tube to receive two conical plugs, which are insulated from the body and from each other by ebonite. Into each plug is fastened a copper pole. The poles are connected by a platinum wire bridge surrounded with priming composition. The lower part of the tube contains pistol powder, and is closed at the bottom by thin discs of paper and by a brass ball embedded in sulphur.

The top of the tube is flat. The terminals come out of the centre of the top, then separate, and are led in opposite directions to the edge. They follow the edge in a groove till they again meet, when they are twisted together for a length of 22 inches. They are insulated by being covered with oiled silk, but as this has been found to be liable to cause the spirals to stick together, they will in future be covered with layers of varnished sarcenet.

Mark IV differed in the internal arrangements for sealing the gas escape.

They are packed 5 in a tin box.

## DRILL FOR 9-INCH R.M.L. GUNS IN CASEMATE OR OPEN BATTERIES.

A gun detachment consists of a Gun Captain (No. 1), a Gun Layer, and seven other gun numbers, with or without "extra gun" numbers.

It falls in two deep, the Gun Captain being on the left of the front rank, and the Gun Layer covering him.

### To Tell Off.\*

<i>Group Officer.†</i>		<i>Gun Captain.</i>
".... Group Tell Off."		".... Tell Off."

At "Tell off" the Gun Captain takes a pace to his front, turns to his right, and gives the word "Tell off."

The Gun Layer does not number.

The right hand man of the rear rank numbers 2, the right hand man of the front rank 3, the second man from the right of the rear rank 4, his front rank man 5, and so on.

After the detachment is told off, the Gun Captain falls in again on the left of the front rank.

The detachment is then moved into the work, and halted in line facing the front, and to the rear of the slide or mounting.

If more than one gun of a group is being manned, each Gun Captain marches his detachment to his gun as above, or to such other convenient position under cover as the Group Officer may direct.

### General Duties.

"The Gun Captain" ‡—(No. 1) commands, and is responsible to the Group Officer for the regular and efficient service of the gun in all respects.

He will satisfy himself that the Gun Layer knows the target ordered.

When his gun is fought by Position Finder (P.F.), he will insert the firing plug after the gun is laid.

Reads and gives Q.E. to elevating numbers when the latter cannot read the means themselves.

When time fuzes are employed he bores them.

Gun Layer.—His special duty is the laying of the gun.

When direction is given by the traversing arc, he reads the training and directs (by signal) the traversing numbers.

\* This should be done as far as possible on private parade, before marching off from parade, camp or quarters.

† In exceptional cases the Gun Captain may also have to perform the duties of Group Officer.

‡ It is recommended that, when feasible, this N.C. officer should have permanent charge of the gun, and be responsible for its condition and cleanliness, and all the stores, &c., connected with it, and also for the casemate or emplacement in which it is mounted.



He always attends to the vent, and makes ready.

No. 2.—Searches, inserts automatic gas checks when used, hooks and unhooks hoisting tackle, steadies and guides projectile, removes selvagee, rams home, replaces rammer, closes mantlet, traverses and sponges.

No. 3.—Attends to port bar, when used, and upper block of hoisting tackle, searches, loads, shifts hoisting tackle, steadies and guides projectile, uncaps fuze or removes safety pin, rams home, closes mantlet, traverses and sponges.

No. 4.—Supplies sidearms and automatic gas checks, when used, rams home, runs up, elevates, fires, and opens mantlet.

No. 5.—Attends to snatch block and lower block of hoisting tackle, raises projectiles, rams home, supplies wedge wads, runs up, elevates and opens mantlet.

No. 6.—Attends to cartridge lift, or outside the cartridge expense store, and supplies cartridges to 3, removing empty cylinder.

No. 7.—Attends to shell lift, or outside the shell expense store, fixes fuzes,\* brings up and raises projectile, and removes empty barrow.

No. 8.—Assists 7 at shell lift, or outside the shell expense store, brings up and raises projectile.

### To Prepare for Action and Examine Gun.

<u>Group Officer.</u>	<u>Gun Captain.</u>
"Prepare for action and Examine Gun."	"Prepare for action." "Examine Gun."

At "Prepare for Action" the following stores are brought up, the higher numbers assisting at the heavier guns.

Gun Layer.—Sights, tubes, tube box, lanyard, pricker and vent server, and at drill a drill tube.

2.—Side arms.

3.—Hoisting tackle and traversing handles.

4.—Iron pointed lever, elevating wheel, rammer rope, and assists 2 with side arms.

5.—Iron pointed lever, elevating wheel, wedgewads, and rammer rope.

6.—Bucket filled and brush, and two wooden cartridge cylinder bearers if required. For drill a zinc cylinder, with drill cartridge.

7 assisted by 8.—Transporting barrow and brush, two selvagees, fuzes, fuze and shell implements, automatic gas-checks as ordered, in boxes, with the lids unscrewed, running back tackle, and piece of chalk. For drill, a drill shell.

Gun Layer receives the tubes from the shell store. He straps the tube box round his waist on right side, and lays the lanyard over the cascable, placing the loop over and the hook through the lanyard guide, and sees that the pointer for training arc is let down. With P.F. he attaches the electrical lanyard, coils it up, and places it in, or near, the firing plug box.

He places the pricker in the loop on the side of carriage, fixes sights, and places the loop of the vent server over one of the hind sights.

\* Time fuzes he will receive from the Gun Captain ready bored.

2 places the sponge and rammer in the brackets on the right of the slide, and the wadhook and shell extractor in a convenient position in rear of the group.

3 puts on traversing handles, secures the hoisting tackle to the loading bar, overhauling it until the lower block is at a convenient height for hooking on to the selvage on the projectile; hooks the lower block to loop on the left mantlet; removes the tampeon, placing it on the right of 5's position when under cover, and ships the port bar.

4 places the iron pointed lever in its supports, puts on elevating wheel, coils down rammer rope between the racers, and assists 2 with side arms.

5 places the iron pointed lever in its supports, puts on elevating wheel, coils down rammer rope between the racers, and places the wedgewads on the right of his position when under cover.

6 supplies sponge tank with water,\* places the sponge bucket and brush on the left of 4's position when under cover, loosens lids or removes bands from cover of cylinders as required, if not already done. At drill he places the zinc cylinder with dummy cartridge at the head of the cartridge lift or outside cartridge expense store.

7 and 8 place the transporting barrow, brush, and selvage (also drill shell) at the head of the shell lift, depôt, or expense store. Place the fuzes, fuze and shell implements, and piece of chalk in a convenient position for the Gun Captain, and the automatic gas-checks on the left of 4's position under cover. They overhaul the running back tackle, and place it in a convenient position in rear of the slide.

The stores having been brought up and found correct, the Gun Captain will give "*Examine Gun*" and see—

That the fuzes, fuze implements, and chalk are ready to his hand.

That the gun itself is properly examined by the numbers whose duty it is to do so.

That the clip plates are attached to the carriage.

That the compressor is in adjustment or the hydraulic buffer properly filled, and piston rod connected up. He should see that the washer of the filling hole plug is in good order. After the gun is run up for the first time after loading, he should admit the air to the buffer by unscrewing the filling plug, and then screw it up tightly.

That a piece of paper is placed in the gas escape hole.

That the racers are clean, and that the top of the side pieces of the slide are free from grease and moisture.

He receives reports from the numbers responsible of any irregularity or deficiency in connection with the different parts of the gun, carriage, slide, and stores.

When firing by Position Finder, he sees that the firing plug is ready for use.

Gun Layer drifts the vent, replaces the pricker, examines the vent server and places it in the vent, examines the sights, sees that the fore sights fit properly and that the deflection leaves of the hind sights work easily.

2 sees that the traversing gear is oiled and in working order, supplies himself with the wadhook, and assisted by 3 searches the gun, taking care that the pricker is not in the vent at the time, and

\* The surface of the water should not be less than 1 inch from the sponge.

replaces wallhook. If the bore is not clean he supplies himself with the sponge, and assisted by 3, sponges, afterwards replacing sponge.

3 examines the bore to see that it is clear and that the grooves are free from grit, and assists 2 to search the gun, and sponge if necessary.

4 sees that the elevating gear is oiled and in working order.

After each number has completed his work as above, he goes under cover.\*

### To Load.

<i>Group Officer.</i>		<i>Gun Captain.</i>
".... Group."		".... Gun."
"†.... Load."		"†.... Load."

Gun Layer.—Adjusts his tangent sight approximately to the range shown on the indicator dial, or other means of passing ranges, or as ordered by the Group Officer, as the case may be, and to the deflection given by Group Officer. He then hooks a tube to the lanyard.

When P.F. is used, he does not touch the tangent sights, but connects up an electric tube.

3 moves into position, withdraws the cartridge from the cylinder with his left hand, and places it in the bore, choke to his left, assisted by 2.

6 supplies a cartridge to 3 (bringing up the cylinder on his left shoulder, lid to the rear), and stands at his right rear.

2 receives an automatic gas check from 4, and places it in the bore (at drill going through the motion only), with the painted side towards the cartridge.

7† and 8 bring up the projectile on its barrow. 5 casts loose the lower block of the hoisting tackle and hands it to 2.

3 shifts the upper block till it is over the muzzle, 2 hooks the lower block into the selvage round the projectile; 3 then gives the signal to "Hoist away," by raising his right arm straight above his head. 2 and 3 steady and guide the projectile, 2 attending to the lower block, 3 to the upper block of the tackle; 3 shifts the empty barrow clear of the raising numbers, 7 removing it altogether after the projectile is in the bore.

The projectile is raised by Nos. 5, 7, and 8.

When the projectile is high enough, 3 again raises his arm above his head, and with 2, forces the projectile into the bore. 3 again raises his arm and waves his hand across. The hoisting numbers then ease off. 2 casts loose the selvage and throws it on to the barrow and receives the rammer from 4; 3 uncaps or removes the safety pin from the fuze; 5 pulls the hoisting tackle out of the way and hooks the lower block back. 4 then supplies the rammer with the right rammer rope attached, 3 hooks the left rammer rope, which he receives from 5, and with 2 steadies the rammer stave. The ropes are manned by 4 and 5.

\* For position of numbers under cover, see pages 50, 51.

† "Palliser," "Common," "Case," or as the case may be, the Group Officer giving the nature and length of fuze if required.

‡ 7 would fix the fuzes, when used, before bringing up the shell, receiving time fuzes ready bored from the Gun Captain.

2 and 3 raise their arms, and the projectile is rammed home. When "home," 2 and 3 again raise their arms, detach the rammer ropes, and hand them to 4 and 5; they then spring the rammer;\* 3 inserts a wedge wad, which he receives from 5, and 2 and 3 press steadily home, jamming it under the head of the projectile with two smart taps (at drill, going through the motion only); the rammer is then sprung and replaced by 2, 3 unships the port bar, and the rammer ropes are coiled or placed clear of the working of the gun by 4 and 5.

The Gun Captain now gives the signal to "*Run Up*," by raising both arms vertically above his head.

At this signal 4 and 5 put their iron pointed levers in the sockets and bear down; should the gun run up too rapidly, they raise their levers and check it.

When the gun is run up, the Gun Captain signals "*Halt*," by holding up his right hand, 4 and 5 raise their levers till the sockets touch the stop plates, and replace them; 2 and 3 close the mantlets.

### Making Ready, Elevating, and Traversing.

As soon as the gun has been run up, the Gun Layer jumps on the slide and places the tube in the vent, except in Case 1,† allowing the toggle to hang over the right side of the carriage. He then proceeds to lay his gun.

When P.F. is used, he puts in the electric tube, and takes care that the lanyard is clear of the slide, so as not to be cut by the gun carriage on recoil. He then goes to the rear of the slide to read the training arc by pointer.

2 and 3 man the traversing handles, 4 and 5 the elevating wheels.

The remaining numbers go under cover.

The Gun Layer gives directions to the elevating numbers in a low tone when tangent scales are used, but when quadrant elevation is used and the elevating numbers cannot read it, the Gun Captain signals to them as follows:—

"*Elevate*."—He holds up either hand, fingers pointing upwards.

"*Depress*."—He turns his hand, so that the fingers point downwards.

"*Halt*."—He slaps his thigh.

For direction the Gun Layer gives the following signals ‡ to the traversing numbers:—

"*Trail Right or Left*."—He motions with his hands, his fingers pointing to the required direction, so as to be best seen by the traversing numbers.

"*Halt*."—He slaps his thigh.

\* Should the projectile be "*not home*," 2 and 3 raise their arms and wave their hands twice across; the projectile is then forced home. A brass screw on the rammer stave shows when the full charge and common shell are "*home*." If a different charge or projectile of a different length is being used, the rammer must be marked accordingly.

† In Case I the tube is not to be inserted until the gun is finally laid.

‡ In some cases the traversing numbers may be unable to see the signals, in which case the Gun Layer will direct them by word of command.

## Laying and Firing.

### CASE I.

#### I.—When elevation and direction are given by Tangent Scale.

The Gun Layer lays the gun with the deflection ordered and the elevation as shown on indicator dials or other means provided for passing ranges, or as ordered by the Group Officer, altering it now and then as the dial or other means alter, or as ordered by the Group Officer, as the case may be,\* until the final range is given as follows:—

#### Final Range.

<u>Group Officer.</u>	<u>Gun Captain.</u>
".... Group."	".... Gun,
or ".... Gun,	.... yards, LAY."
.... yards, LAY."†	

At the order "*Lay*," all the Gun Layers, or only that of the gun named, as the case may be, adjust the tangent sight to the exact elevation named.

If only one or more guns are named, the Gun Layers of the others will continue as before, as well as their elevating and traversing numbers.

NOTE.—If a gun or guns of a group are to be fired as soon as possible after being loaded, the Group Officer should give the "*final range*" immediately the gun or guns are run up.

When firing at a stationary target, the Gun Layer, as soon as he has received the final range and laid his gun, jumps down and goes under cover, the elevating and traversing numbers doing the same, until the Group Officer gives the order.

".... Group," or ".... Gun, *Commence Firing*."

#### Commence Firing.

<u>Group Officer.</u>	<u>Gun Captain.</u>
".... Group,"	(On seeing Gun Layer jump off
or	the slide)
".... Gun,	".... Gun,
<i>Commence Firing</i> ."	<i>Fire</i> ."

At the order, "*Commence Firing*," the Gun Layers of the group or of the gun or guns named, as the case may be, will rapidly make

\* Generally the ranges would be called out by the Group Officer, taken from the dials, &c., and repeated by the Gun Captain.

† If from any cause the gun is not fired at this range, the Group Officer gives the order "*Fresh Lay*," and names a new range, thus, "*Fresh Lay*, ... yds., *Lay*."

any final correction of the laying that may be necessary, place the tube in the vent, and jump off the slide. As soon as the Gun Layer jumps down, 5 goes under cover, 4 seizes the lanyard, and on the order, "*Fire*," from the Gun Captain, fires, afterwards throwing the lanyard over the cascable.

2 and 3 remain on the traversing handles until the gun is fired.

## CASE II.

II.—When using sighting steps, straight edge sights,\* and quadrant elevation.

The Gun Layer stands on the sighting steps, and keeps his gun trained on the target, laying only for direction.

4 and 5 elevate or depress to the elevation ordered by signal from the Gun Captain reading the quadrant elevation, unless means are provided which they can read themselves, when they will take it from such means, the number on the side on which the quadrant elevation can best be read giving the same.

The "elevation ordered" will be that shown on the indicator, or other means of exhibiting ranges, or as ordered by the Group Officer, as the case may be.†

## Final Range.

<i>Group Officer.</i>	<i>Gun Captain.</i>
".... <i>Group</i> ,"	".... <i>Gun</i> ,"
or	.... <i>Yards, LAY.</i> "
".... <i>Gun</i> ,"	
.... <i>Yards, LAY.</i> "‡	

At the order "*LAY*," the Gun Captain carefully gives the final elevation ordered.

5 then goes under cover, 4 seizes the lanyard and stretches it taut.

## Commence Firing.

<i>Group Officer.</i>	<i>Gun Captain.</i>
".... <i>Group</i> ,"	(On getting signal from Gun
or	Layer)
".... <i>Gun</i> ,"	".... <i>Gun</i> ,"
<i>Commence Firing.</i> "	<i>Fire.</i> "

At the order, "*Commence Firing*," the Gun Layer will rapidly make any final correction, and hold up his right hand over his head when on the target. He remains when possible on the sighting steps. 4 fires the gun on the order "*Fire*," from the Gun Captain, and throws back the lanyard over the cascable. 2 and 3 remain on the traversing handles until the gun is fired.

\* During the loading, the Gun Layer will have set the tangent scale at the approximate range, or as ordered; it may be necessary, however, for him to further alter it, in order that the target may be in the field of the straight edge. Also, see p. 6.

† See note \* on p. 47.

‡ See note † on p. 47.

## CASE III.

III. — *With quadrant elevation and training arc.*

4 and 5 elevate or depress as in Case II, except that when P.F. is used they give the elevation, as called by the dial number, directed, if necessary, by the Gun Captain.

The Gun Layer reads the training by pointer, as given by Group Officer or otherwise (or with P.F. by the dial number), and signals to the traversing numbers as required.

## Final Range.

On the caution from the Group Officer or "dial number," "Range... Yards ... Training ... Degrees, Lay,"\* 4 and 5 give the exact elevation called out, directed, if necessary, by the Gun Captain, and go under cover, unless when firing is not with P.F., when 4 seizes the lanyard and stretches it taut.

The Gun Layer, with the help of 2 and 3, gives the exact training, and goes under cover; 2 and 3 remaining on the handles, except when the firing is by P.F.

## Commence Firing.

The Gun Captain satisfies himself that the gun is laid on the proper target.

If P.F. is not used, the words of command will be as in Case II, and 4 will fire on the Gun Captain giving the word.

When firing by P.F., the Gun Captain puts in the firing plug and runs to the rear of the slide, where he can best be seen by the Group Officer, holding up his hand in line with his shoulder; in casemated works he must however often inform the Group Officer, if he cannot be seen by him, by word of mouth, signal or otherwise, as most convenient.†

When the Group Officer gives to the dial number the word or signal to "*Commence Firing*," he goes under cover.

## Sponging Out.

*In all the above Cases.*

As soon as the gun is fired, the Gun Captain removes the firing plug if P.F. is used, the Gun Layer in all cases drifts the vent, re-adjusts the lanyard, and replaces the pricker and vent server; or with P.F., coils up the lanyard and puts it in the firing plug box, or other convenient place; 4 and 5 attend to mantlets, assisted by higher numbers when necessary, 3 ships the port bar, 4 supplies the sponge, and 2 and 3 sponge out the gun; 4 replaces the sponge, 5 overhauls the hoisting tackle.

\* See note † on p. 47.

† Should a fresh prediction be necessary, or the signal or order, "*Stand Fast*," be given before the Group Officer orders, "*Commence Firing*," the Gun Captain will immediately remove the firing plug, and the service of the gun will continue as before.



### To Run Back and Unload at Drill.

As soon as the gun has been fired, the Gun Layer having drifted the vent and replaced the pricker, vent server, and lanyard, the Gun Captain gives the signal to run back by holding up both hands over his head.

He then disconnects the traversing gear by shifting and keying up the handle, 6 and 7 fix the running back tackle, take two turns round the bollard, and hold on to the fall. 4 and 5 then apply their levers and bear down, 2 and 3 attending to the pawls.

The traversing handles are manned by 2, 3, 4 and 5.

The Gun Captain raises his right arm, and the numbers heave round, the Gun Layer following up the right front roller with a wedge wad. As soon as the gun is back, he again raises his right arm.

4 and 5 then apply their levers and bear down, 6 and 7 remove the tackle: the Gun Captain shifts the gear to traversing.

2 and 3 remain on the traversing handles until the carriage is lowered.

The gun is unloaded by the same numbers as loaded it, 3 shipping the port bar, 4 supplying extractor and searcher.

As soon as the gun is unloaded, 4 supplies the sponge, 2 and 3 sponge out, and 5 overhauls the hoisting tackle.

### To Cease Firing and Replace Stores.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"... Group."	"... Gun."
"Cease Firing and replace Stores."	"Cease Firing and replace Stores."

The Gun Captain sees that the gun is depressed to an angle of about 4 degrees. The stores are returned by the numbers who brought them up.

After replacing stores, the detachment falls in two deep in rear of the gun as at first.

### To take Post under Cover and Form Detachment Rear.

These movements are required at times; they will be as follows:—

#### To take Post under Cover.

<i>Group Officer.</i>	<i>Gun Captain.</i>
"Take Post under Cover."	"Double March."

Each man doubles at once to his position as follows.\* They should all, if possible, be sitting or lying down.

\* But they may be locally arranged for otherwise so long as the men know exactly where to go to, and are near enough to spring rapidly to their work.

Gun Captain.—Where he can best retain his position for superintending the working of the gun.

Gun Layer.—In rear of the slide when possible.

Nos. 2 and 4.—On the right of the gun.

Nos. 3 and 5.—On the left of the gun.

2 and 3 being next the muzzle, and 4 and 5 outside them.

No. 6.—At the head of the cartridge lift, or outside cartridge expense store.

Nos. 7 and 8.—At the head of the shell lift, or outside shell expense store.

### To Form Detachment Rear.

*Group Officer.*

*"Detachment Rear."*

*Gun Captain.*

*"Double March."*

The Gun Captain doubles out and places himself at the rear of the platform, facing to the front; on the word, "*Double March*," the numbers double to their places in "*Detachment Rear*," halting and fronting as they come up.



## DRILL FOR 9-IN. R.M.L. GUNS IN BARBETTE BATTERIES.

### (1.) ON DWARF SLIDES.

The guns are fitted with muzzle derricks.

The service is the same as for guns mounted in casemates, with the following exceptions :—

#### General Duties.

4 assists with muzzle derrick, 5 attends to muzzle derrick. (The detail at page 43, relative to mantlets and port bar, and shifting hoisting tackle by No. 3 is omitted.)

#### To Prepare for Action, and Examine Gun.

Rammer ropes are not supplied, 3 brings up spun yarn and mouses the hook of the upper block of the hoisting tackle, and overhauls the tackle, placing the lower block on the muzzle of the gun.

#### To Load.

4 and 5 raise the derrick. In ramming home, 4 and 5 man the rammer stave with 2 and 3. After the projectile is rammed home, 4 and 5 throw back the derrick, 5 makes up the fall, and lays it on top of the gun.

After the gun has been fired, 5 overhauls the hoisting tackle (except at drill).

If the guns are not fitted for muzzle derricks, the projectile is carried to the gun in a shell bearer by 7 and 8, 2 and 3 assisting in raising it to the muzzle.

### (2.) ON MARK I 7-FT. PARAPET SLIDES, WITH SUNKEN WAYS.

The slides are fitted with fixed loading derricks and stages (one derrick to be kept in store). The running end of the fall of the hoisting tackle is led through a snatch block, which is hooked to the foot of the derrick.

Two guides for rammer ropes are attached to the carriage; snatch blocks are therefore not required.

The service is the same as above, except in loading, when :—

4 and 5 attend to the loading derrick, 5 fixes the catch to secure derrick to pillar for loading, 8 hooks lower block of hoisting tackle (after the projectile is rammed home, 4 and 5 lower the derrick).

4 and 5 pass the rammer ropes through the guides on carriage. The projectile is brought up, as with guns in casemates, on right or left of loading stage, depending on which side the derrick is used.

In laying, the Gun Layer directs the traversing numbers by word of command, instead of by signals.

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# DRILL FOR 9-IN. R.M.L. GUNS ON MARK II CARRIAGES AND MARK III OR IV 7-FT. PARAPET SLIDES WITH SUNKEN WAYS.

This mounting is constructed to fire at angles of elevation up to 20°, and consists of the following additions to that of the ordinary mounting:—

- (a.) Loading stage.
- (b.) Two loading derricks.
- (c.) Three thrust blocks.
- (d.) Two hydraulic buffers.

On the left side of this particular carriage has been fitted a Watkin multiplier for giving the elevation. It is graduated up to 10,000 yards.

(a.) Is attached to the slide for numbers 2 and 3 to stand on during loading.

(b.) Are attached to the front of the slide; one being on each side of the muzzle of the gun, and capable of being rotated.

(c.) Two of these are attached to the undersurface of the slide opposite the pivot, and when supporting it they are bearing on the pivot plate of the emplacement.

The other block is at the front of the slide, and when supporting it bears on the racer.

To enable these blocks to be put in bearing, each is fitted with a capstan head, into which the iron pointed levers can be applied.

(d.) These are inside the slide and are fitted with valves to regulate the recoil. The scale by which these are regulated is fitted to the front of the carriage.

The traversing gear is worked at the rear of the slide.

The service of the gun is the same as for those mounted in casemates with the following exceptions:—

## To Prepare for Action and Examine Gun.

No. 3 secures the hoisting tackle to the loading derrick (mousing the hook of the upper block with a piece of spun yarn), overhauls it, till the lower block is convenient to hook to the selvage round the projectile, then hooks it to the front eyebolt of the slide, making the fall fast to one of the cleats on the derrick, and places the remainder of the fall on the stage coiled down.

The rammer ropes are coiled down clear of the pivot plate inside the racer.

No. 4 takes his iron pointed lever and applies it in the capstan head of the front thrust block and assisted by 5 screws this block down into bearing on the racer. They then adjust the thrust blocks on their own sides in bearing on to the pivot plate. The front thrust block is then raised (to admit of traversing) *just clear of the racer*.

The side blocks being once properly adjusted should not require any further adjustment.

No. 7, also a McMahon spanner.

## General Duties.

*Gun Captain.*—Attends to the indicator of the hydraulic buffers, adjusting it according to the mean elevation likely to be given to the gun.\*

He is also responsible that the slide is resting on the thrust blocks before the gun is fired when the elevation exceeds 5,000 yards, and, after it is fired, that they are raised immediately.

No. 5 attends to the loading derrick, and to lower block of hoisting tackle.

Nos. 4 and 5 attend to the capstan heads of thrust blocks.

## To Load.

After the cartridge has been placed in the bore, Nos. 2 and 3 ram it home, 2 handing the rammer back to 4, who attaches the rammer ropes, &c.

While 2 and 3 are ramming home the cartridge, 5 hooks the hoisting tackle to the selvagee. After the projectile has been rammed home, 5 overhauls the tackle as before.

The derrick is swung round by Nos. 2 and 3 when the projectile is "high enough."

## Run Up.

After the gun has been "run up," the Gun Captain will adjust the indicator as follows:—

Up to 6,000 yards at 2,	
" 7,500 " 2½,	
Above " " 3.	

## Final Range.

*Case III only used.*

After the final elevation has been given to the gun, 4 and 5 mount on the loading stage, 4 taking his iron-pointed lever with him, and applies it in the capstan head of the front thrust block; he then looks towards the Gun Layer, who will signal to him, when the final training has been given, by holding his right hand above his head; 4 and 5 will then screw the block down on to the racer and go under cover. Should the side blocks not be in bearing they will also screw them down before going under cover.

After the gun has been fired they will immediately raise the front block. Nos. 2 and 3 will depress the gun into a position for loading.

\* The greater the elevation the greater should be the opening of the valve.

## DRILL FOR 9-IN. R.M.L. GUN ON MONCRIEFF CARRIAGE, MARK II.

The detachment consists of a Gun Captain (No. 1), a Gun Layer, and seven other gun numbers.

The detail for telling off the detachment and forming up is the same as given for guns on traversing slides, and the drill is similar, with the following exceptions:—

### General Duties.

3 attends to hoisting chain,	} In addition to their other duties.
5 traverses and attends to brake in running up,	
7 and 8 man hoisting chains,	

### To Prepare for Action and Examine Gun.

No iron-shod levers are required.

The sponge and rammer are laid down on the right of the gun close to the parapet, heads towards the parapet; the shell extractor and searcher outside the pit.

4 supplies 2 with the searcher and replaces it, and attends to elevating wheel, and depresses after the gun has been searched until the muzzle rests on the elevator.

2 places the sponge and rammer in the tray beneath the sides of the slide.

3 brings up handle of hoisting winch and places it on the spindle outside the left side of the slide.

### To Load.

The Gun Captain gets the gun into a convenient position, *i.e.*, the upper edge of the counterweight nearly horizontal; 4 depresses the gun if necessary. 2 and 3 open the flaps of the loading stage between the sides of the slide. 7 and 8 bring up the projectile on its barrow, with selvagee on, and run it on to tray beneath muzzle of gun; 2 hooks hoisting tackle to selvagee round projectile; 3 then gives signal to "Hoist away" by raising his right hand vertically above his head. 2 and 3 steady and guide the projectile which is raised by 5 and 7 manning the winch handle. When the projectile is clear of the barrow, 3 moves the latter clear. When the projectile is "High enough," 3 again raises his arm above his head, and with 2 forces the projectile into the bore. 3 again raises his arm and waves his hand across; the numbers on the winch handle then ease off, 3 casts loose the selvagee and throws it on the barrow. 7 removes the empty barrow. 2 and 3 close the flaps of the loading stage. 4 and 5 assist to ram home if necessary.

### To Run Up.

2 and 3 throw back the pawls of the retaining racks, and, before running up, the Gun Captain will give the caution "Stand Clear." 5, holding the brake, allows the gun to run up as far as it will go.

(this is very important when using Q.E.). When up the Gun Captain signals "Halt." 5 must be very careful not to allow it to escape from his control, and, on the other hand, he must not check it too soon. Should the latter be the case, the Gun Captain gives "Work levers;" 2 and 4 man the right, 3 and 5 the left, lever, small ends to the rear; 2 and 3 fixing the latches; the Gun Captain will give "Down," "Fresh purchase," "Halt," as required. When the gun is up 4 and 5 unship the levers, 2 and 3 slacken the latches and man the front traversing handles, 4 the elevating wheel, 5 the rear traversing handle.

### To Run Back and Unload at Drill.

2 and 3 fix the latches and, with 4 and 5, work the levers, the Gun Captain giving "Down," "Fresh purchase," "Halt," as required. When tackles are used they are hooked by 6 and 7, and manned by all the available numbers. Extra numbers will also be required. Unloading should be effected from the firing position before the gun is run back.

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### DRILL FOR 9-IN. R.M.L. GUN ON HIGH-ANGLE MOUNTING.

The drill is similar to 9-in. R.M.L. guns on traversing slides, with the following exceptions:—

#### General Duties.

- No. 2 mounts on parapet and runs up loading trolley.
- No. 3 mounts on parapet, runs up loading trolley, and releases projectile.
- No. 4\* depresses gun to loading position, and raises projectile.
- No. 5\* assists 6 with cartridges.
- No. 8 attends to hoisting tackle.

#### Prepare for Action† and Examine Gun.

No. 5.—Pressure indicator and spanners.

No. 8.—One set of hoisting tackle.

The Gun Captain will see that the roller path is clean, he will attach the pressure indicator, and test the pressure in the cylinders, and test the level of liquid in each cylinder.‡ He will see that the clip plates are secured to the mounting.

Gun Layer.—Rimer and tube extractor, instead of the pricker and vent server, also a grease pot.

He straps the tube box round his waist. He opens the shutter, inserts a tube (well lubricated with grease), closes the shutter and

\* 4 and 5 do not ram home or run up.

† Iron-pointed levers, wedge wads, and running-back tackles not required.

‡ For method of charging and testing cylinders, see Instructions for Care and Preservation.



fires it before the gun is searched; the Gun Captain being careful to see that no number is in front of the muzzle while the tube is being fired.

There being no vent server with this gun, the old tube is always to be in the vent during sponging and loading.

The detail relating to "He then drifts the vent" to "over one of the hind sights" is cancelled.

No. 2 sees that the trolley is in good working order; he receives the searcher and sponge from 4 and hands them back to him.

No. 6 places the sponge bucket close to the sponge head.

Nos. 7 and 8 hook the upper block of the hoisting tackle to the derrick and mouse the hook, overhauling the tackle until the lower block is in a convenient position for hooking into the selvagee round the projectile, they then place the stores they have brought up in a convenient position for use at drill.

### To Load.

The Gun Layer connects up an electric tube to the lanyard, and after the rammer is withdrawn and 2 and 3 are off the parapet, places the tube in the vent, seeing that the lanyard is hanging so that it will not be cut by the recoil of the gun.

2 and 3 mount on the parapet.

3 withdraws the cartridges from the cylinder with his left hand and places them in the bore, choke to the left.

6 supplies cartridges to 3 (bringing up the cylinder on his left shoulder, lid to the rear) and stands close to the parapet on the left side of the mounting. 5 assists him. 6 replaces the empty cylinder. 2 receives an automatic gas-check from 4, and places it in the bore (at drill going through the motion only) with the painted side towards the cartridges. 7 and 8 bring up a projectile on its barrow. 4 hooks lower block of tackle to selvagee round the projectile. 2 (at the upper block) then gives the signal "Hoist away" by raising his right arm straight above his head. The projectile is raised by 4, 7, and 8. When it is high enough 2 again raises his arm above his head, and, with 3, forces the projectile on to the loading trolley. 2 again raises his arm and waves it across, when the hoisting numbers ease off; 2 casts loose the selvagee and throws it on the barrow. 2 and 3 then move the trolley round in front of the muzzle, 3 releases the projectile and removes the safety pin, or uncaps the fuze. 2 receives the rammer from 4. 2 and 3 then ram home the projectile and withdraw the rammer, 2 handing it back to 4, who replaces it. 2 and 3 then move the trolley clear of the muzzle, and dismount from the parapet. 7 removes the barrow and selvagee. 8 overhauls the hoisting tackle.

### Cease Firing and Replace Stores.

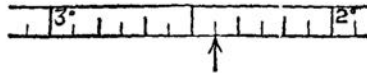
The Gun Captain will see that the gun is depressed until the muzzle touches the parapet.



### INSTRUCTIONS FOR USING LARGE CLINOMETER.

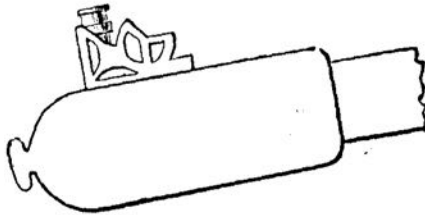
*To read the angles marked on the drum.*—The brass drum is marked in degrees, commencing at  $0^\circ$  on the top to  $45^\circ$  at the bottom. Each degree is subdivided into twelve parts; each small division therefore represents an angle of 5 minutes.

The scale is read from right to left, thus—

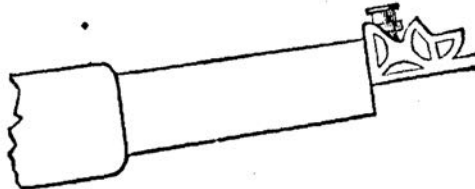


the reading opposite the arrow would indicate an angle of  $2^\circ 25'$ .

*To lay a gun at any angle up to  $45^\circ$ .*—Unscrew the drum, until the  $\uparrow$  points to the elevation required; place the clinometer, thus—

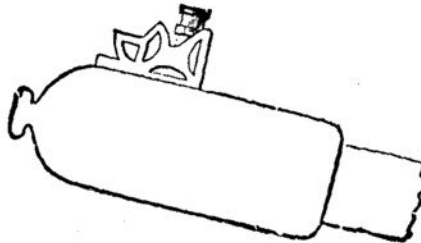


on the plane surface cut on the breech, or against the muzzle, thus—

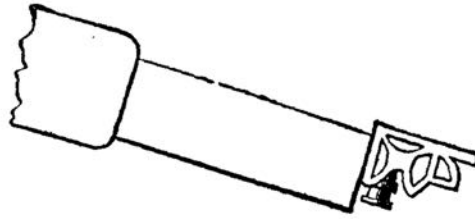


and elevate the piece until the bubble of the spirit-level is in the centre of the tube.

*For angles of depression.*—Proceed as above, but reverse the direction of the instrument, placing it thus on the breech of the gun—



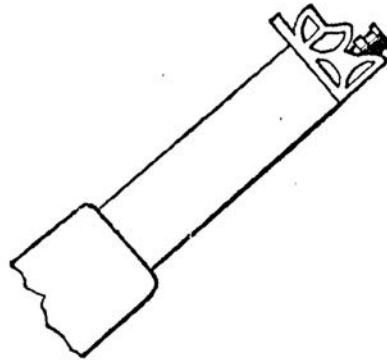
and thus on the muzzle—



*For angles of elevation greater than 45°.—*Subtract the angle of elevation required from 90°, unscrew the drum to this reading; thus, for 60°, unscrew the drum to 30°, and place the instrument on the breech of the gun, thus—



or on the muzzle, thus—



and elevate until the bubble is in the centre of its run.

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# RANGE TABLE for 9-inch R.M.L. Gun, Marks I to V (Revised 4, 85).

Based on Practice of 15. 1. 79; 29. 5. 79; 1. 9. 81; 19. 5. 82; 4. 7. 82.

Charge, 50 lb. P.; gravimetric density,  $\frac{26.1}{1.062}$ .

Muzzle velocity, 1440 f. s.

Projectile, studded with Mark II gas-check, or  
studded with automatic gas-check, weight  
257 lb.

Mounting—Iron Garrison.  
Jump—9 minutes.

Range, yards.	Elevation, °	Angle of de- scend., °	Slope of de- scend., 1 in.	5 minutes' ele- vation in- creases or de- creases the range by yards.	5 minutes will alter point of impact verti- cally or later- ally at each range. yards.	Remaining velocity, f. s.	Penetration wrought iron, inches.	Time of flight, secs.	50 per cent. of rounds should fall within			Fuze scale 15-seconds wood time fuze with detonator, Mark III.
									Length, yards.	Breadth, yards.	Height, feet.	
0		0 8	430	60	0.14	1421	11.3	0.21	20	0.04	0.2	250
100	0 7	0 16	212	59	0.29	1402	11.1	0.42	20	0.09	0.3	340
200	0 16	0 25	138	58	0.43	1384	11.0	0.64	20	0.13	0.5	430
300	0 24	0 34	101	57	0.58	1366	10.8	0.86	20	0.18	0.6	520
400	0 33	0 44	78	56	0.72	1348	10.7	1.08	20	0.22	0.8	610
500	0 42	0 54	61	55	0.87	1331	10.5	1.31	20	0.27	1.0	695
600	0 51	1 4	54	54	1.01	1314	10.4	1.54	20	0.32	1.1	780
700	1 0	1 14	46	53	1.16	1297	10.2	1.77	20	0.36	1.3	865
800	1 9	1 24	41	52	1.31	1280	10.1	2.00	20	0.41	1.5	945
900	1 18	1 35	36	51	1.45	1264	9.9	2.24	20	0.46	1.7	1030
1000	1 28	1 46	32	50	1.60	1248	9.8	2.48	20	0.51	1.9	1115
1100	1 38	1 57	29	49	1.74	1233	9.6	2.72	21	0.56	2.1	1200
1200	1 48	2 9	27	48	1.89	1218	9.5	2.97	21	0.61	2.3	1280
1300	1 58	2 22	24	47	2.03	1204	9.4	3.21	21	0.67	2.6	1365
1400	2 8	2 34	22	46	2.18	1190	9.2	3.46	21	0.72	2.9	1445
1500	2 19	2 47	21	45	2.32	1176	9.1	3.71	22	0.78	3.2	1530
1600	2 30	3 1	19	44	2.47	1162	9.0	3.97	22	0.83	3.5	1610
1700	2 41	3 15	18	43	2.61	1149	8.8	4.23	22	0.89	3.8	1690
1800	2 52	3 30	16	43	2.76	1136	8.7	4.49	22	0.94	4.1	1770
1900	3 3	3 45	15	42	2.91	1124	8.6	4.76	23	1.0	4.5	1850
2000	3 14	4 1	14	42	3.05	1111	8.5	5.03	23	1.1	4.8	1925
2100	3 26	4 17	13	41	3.21	1099	8.4	5.31	23	1.1	5.2	2005
2200	3 38	4 33	13	41	3.34	1088	8.3	5.59	23	1.2	5.6	2080
2300	3 50	4 50	12	40	3.49	1077	8.2	5.88	24	1.3	6.0	2155
2400	4 2	5 7	11	40	3.63	1067	8.1	6.17	24	1.3	6.5	2230
2500	4 14	5 24	11	39	3.78	1058	8.0	6.46	24	1.4	6.9	2300
2600	4 26	5 41	10	39	3.92	1049	8.0	6.76	25	1.5	7.4	2370
2700	4 38	5 59	9.6	38	4.07	1040	7.9	7.06	25	1.5	7.9	2440
2800	4 51	6 17	9.1	38	4.21	1032	7.8	7.37	25	1.6	8.4	2510
2900	5 4	6 35	8.7	37	4.36	1024	7.7	7.67	26	1.7	9.0	2580
3000	5 17	6 54	8.3	37	4.51	1017	7.7	7.98	26	1.7	9.6	2650
3100	5 30	7 13	7.9	36	4.65	1010	7.6	8.28	26	1.8	10	2720
3200	5 44	7 32	7.5	36	4.80	1004	7.5	8.59	27	1.9	11	2790
3300	5 58	7 51	7.2	35	4.94	997	7.5	8.90	27	2.0	11	2860
3400	6 12	8 10	6.9	35	5.09	991	7.4	9.21	27	2.1	12	2930
3500	6 26	8 29	6.7	34	5.23	985	7.4	9.52	28	2.2	13	3000
3600	6 41	8 49	6.4	34	5.38	978	7.3	9.83	28	2.3	13	3070
3700	6 55	9 9	6.2	33	5.52	972	7.3	10.1	28	2.4	14	3140
3800	7 11	9 29	6.0	33	5.67	966	7.2	10.4	28	2.5	15	3210
3900	7 26	9 50	5.8	32	5.81	960	7.2	10.7	29	2.6	16	3280
4000	7 41	10 11	5.6	32	5.96	954	7.1	11.1	—	—	—	3350
4100	7 56	10 33	5.4	32	6.11	948	7.1	11.4	—	—	—	3420
4200	8 12	10 55	5.2	31	6.25	942	7.0	11.7	—	—	—	3485
4300	8 28	11 17	5.0	31	6.40	936	7.0	12.1	—	—	—	3550
4400	8 44	11 40	4.8	31	6.54	930	6.9	12.4	—	—	—	3615
4500	9 0	12 3	4.7	30	6.69	924	6.9	12.7	—	—	—	3680
4600	9 16	12 27	4.5	30	6.83	918	6.8	13.0	—	—	—	3745
4700	9 33	12 51	4.4	30	6.98	912	6.8	13.4	—	—	—	3810
4800	9 50	13 16	4.2	29	7.13	906	6.7	13.7	—	—	—	3875
4900	10 7	13 41	4.1	29	7.27	900	6.7	14.0	—	—	—	3940
5000	10 24	14 7	4.0	29	7.42	895	6.6	14.4	—	—	—	4000
5100	10 41	14 34	3.8	28	7.56	890	6.6	14.7	—	—	—	4065
5200	10 59	15 1	3.7	28	7.71	885	6.6	15.0	—	—	—	4125
5300	11 17	15 29	3.6	28	7.85	880	6.5	15.4	—	—	—	4190
5400	11 35	16 58	3.5	27	8.00	875	6.5	15.7	—	—	—	4245
5500	11 53	17 28	3.4	27	8.14	870	6.4	16.1	—	—	—	4310
5600	12 11	18 59	3.3	27	8.29	865	6.4	16.4	—	—	—	4370
5700	12 29	19 31	3.2	26	8.43	860	6.3	16.7	—	—	—	4435
5800	12 48	20 4	3.1	26	8.58	855	6.3	17.2	—	—	—	4500
5900	13 7	21 17	3.0	26	8.73	850	6.3	17.5	—	—	—	30.0

Based on Practice of 30. and 31. 8. 81.

Muzzle velocity, 1096 f. s.  
Jump, 14 minutes.

Range.	Elevation.	Angle of descent.	Slope of descent.	5 minutes elevation increases or decreases the range by	5 minutes will alter point of impact vertically or laterally at each range	Remain- ing velocity.	Pene- tration, wrought- iron.	Time of flight.	50 per cent. of rounds should fall within			Fuze Scale.	
									Length.	Breadth.	Height.	Range.	Tenths of Fuze.
yards.	° ' "	° ' "	1 in.	yards	yards	f. s.	inches.	seconds	yards	yards	yards	yards	
300	0 28	0 35	93	25.6	0.43	1,069	8.1	0.81	3.7	0.20	0.03	160	1.0
400	0 42	0 49	79	25.2	0.58	1,060	8.0	1.17	5.0	0.26	0.07	250	1.5
500	0 56	1 9	50	34.8	0.72	1,051	7.9	1.43	6.3	0.33	0.13	330	2.0
600	1 10	1 24	41	34.4	0.87	1,042	7.8	1.69	7.6	0.40	0.19	420	2.5
700	1 24	1 41	31	34.0	1.01	1,033	7.7	1.95	9.0	0.47	0.26	500	3.0
800	1 38	1 56	29	33.7	1.16	1,024	7.6	2.23	10.4	0.53	0.25	580	3.5
900	1 52	2 12	26	33.4	1.31	1,015	7.5	2.52	11.8	0.60	0.45	670	4.0
1,000	2 7	2 32	23	33.0	1.45	1,007	7.5	2.81	13.2	0.67	0.58	750	4.5
1,100	2 22	2 49	20	32.6	1.60	1,000	7.5	3.10	14.7	0.74	0.73	830	5.0
1,200	2 37	3 10	18	32.2	1.74	993	7.4	3.40	16.2	0.82	0.87	920	5.5
1,300	2 52	3 28	16	31.8	1.89	986	7.4	3.70	17.7	0.90	1.07	1,000	6.0
1,400	3 7	3 41	15	31.5	2.03	979	7.3	4.00	19.2	0.98	1.27	1,080	6.5
1,500	3 23	4 0	14	31.2	2.18	972	7.2	4.32	20.7	1.06	1.46	1,170	7.0
1,600	3 39	4 22	13	30.6	2.32	965	7.2	4.64	22.4	1.14	1.72	1,250	7.5
1,700	3 55	4 44	12	30.0	2.47	959	7.1	4.96	24.1	1.22	2.01	1,330	8.0
1,800	4 11	5 6	11	29.4	2.61	953	7.1	5.28	25.8	1.31	2.30	1,420	8.5
1,900	4 28	5 38	10	27.8	2.76	947	7.0	5.60	27.5	1.40	2.72	1,500	9.0
2,000	4 46	6 8	9.3	27.0	2.91	941	7.0	5.95	29.3	1.49	3.16	1,580	9.5
2,100	5 4	6 35	8.7	26.3	3.05	935	6.9	6.30	31.1	1.58	3.62	1,660	10.0
2,200	5 23	7 8	8.0	25.6	3.20	929	6.9	6.65	33.0	1.68	4.17	1,740	10.5
2,300	5 42	7 34	7.5	25.0	3.34	922	6.8	7.00	35.0	1.78	4.68	1,820	11.0
2,400	6 2	8 6	7.0	24.4	3.49	917	6.8	7.35	37.0	1.88	5.23	1,900	11.5
2,500	6 22	8 37	6.6	23.8	3.63	911	6.7	7.72	39.0	1.98	5.94	2,000	12.0
2,600	6 43	9 15	6.2	23.2	3.78	905	6.7	8.09	41.0	2.08	6.73	2,100	12.5
2,700	7 4	9 42	5.8	22.7	3.92	899	6.6	8.48	43.1	2.18	7.43	2,200	13.0
2,800	7 26	10 18	5.5	22.3	4.07	893	6.6	8.86	45.2	2.28	8.25	2,300	13.5
2,900	7 49	10 45	5.2	22.0	4.21	888	6.5	9.25	47.4	2.38	9.06	2,400	14.0
3,000	8 10	11 11	5.0	21.7	4.36	883	6.5	9.64	49.7	2.48	10.00	2,500	14.5
3,100	8 33	11 59	4.7	21.2	4.51	878	6.4	10.03	52.0	2.58	11.10	2,600	15.0
3,200	8 56	12 20	4.5	20.8	4.65	873	6.4	10.42	54.3	2.69	12.20	2,700	15.5
3,300	9 20	13 8	4.3	20.6	4.80	868	6.3	10.82	56.7	2.80	13.30	2,800	16.0
3,400	9 44	13 40	4.1	20.4	4.94	863	6.3	11.22	59.2	2.91	14.50	2,900	16.5
3,500	10 8	14 11	3.9	20.2	5.09	858	6.3	11.63	61.7	3.02	15.70	3,000	17.0
3,600												3,100	17.5
3,700												3,200	18.0
3,800												3,300	18.5
3,900												3,400	19.0
4,000												3,500	19.5

# RANGE TABLE for 9-inch R.M.L. Gun, Mark VIa.

Based on Practice of 26. 11. 91 and 2. 12. 92.

Charge { weight, 50 lb.  
gravimetric density,  $\frac{31.6}{0.877}$   
Nature of powder, S.P.  
W.A., lot 4720.

Projectile { nature, Palliser.  
weight, 360 lb.  
Muzzle velocity, 1194 f.s.

Nature of Mounting, High-Angle Fire Mounting, R.C.D. No. 1280 A.

Range.	Elevation.	Angle of Descent.	Slope of Descent.	5 minutes' elevation will alter Range by	Remain- ing Velocity.	Drift Right.	Drift Angle.	Time of Flight.
yards.	° /	° /	1 in.	yards.	f.s.	yards.	° /	seconds.
9100	30 0	40 31	1.17	12	798	157	1 0	34.5
9200	30 42	41 1	1.52	11	806	169	1 3	35.5
9300	31 29	41 52	1.5	10	809	181	1 5	36.5
9400	32 16	42 4	1.1	9	816	193	1 7	37.5
9500	33 0	42 37	1.08	8	820	205	1 9	38.5
9600	53 45	43 13	1.05	7	825	217	1 12	39.5
9700	34 37	43 53	1.02	6	831	229	1 16	40.4
9800	35 30	44 36	0.99	5	838	240	1 21	41.2
9900	36 33	45 22	0.97	4	841	252	1 26	42.0
10000	37 36	46 13	0.93	3	844	265	1 32	43.0
10100	39 33	49 30	0.83	2	847	277	1 46	43.8
10200	41 30	53 22	0.75	1	853	290	1 50	44.5
10230	43 48	56 0	0.71	1	859	305	1 54	45.5
10200	45 24	57 30	0.67	1	865	320	2 18	46.5
10100	48 12	60 30	0.67	2	871	370	2 24	47.3
10000	51 0	62 14	0.63	2	876	417	2 30	48.2
9900	52 18	63 33	0.59	2	881	423	2 36	48.8
9800	53 36	64 35	0.55	2	886	429	2 42	49.5
9700	54 30	65 20	0.52	3	890	446	2 48	50.2
9600	55 24	66 15	0.49	3	895	462	2 53	51.0
9500	56 8	66 53	0.47	3	899	472	2 59	51.5
9400	56 52	67 29	0.45	4	904	483	3 5	52.0
9300	57 28	68 1	0.43	4	909	494	3 11	52.7
9200	58 8	68 31	0.41	5	913	505	3 17	53.5
9100	58 46	68 58	0.39	5	918	516	3 23	54.2
9000	59 15	69 22	0.37	6	922	527	3 29	54.8
8900	59 45	69 46	0.36	7	926	539	3 34	55.2
8800	60 14	70 10	0.36	8	930	550	3 39	55.5
8700	60 43	70 33	0.35	9	934	560	3 46	56.0
8600	61 12	71 29	0.34	10	938	570	3 53	56.5
8500	61 39	71 43	0.33	11	942	582	3 58	57.0
8400	62 6	72 6	0.33	12	946	593	4 4	57.5
8300	62 34	72 28	0.32	13	950	604	4 10	58.0
8200	63 3	72 50	0.32	14	954	615	4 17	58.5
8100	63 24	73 12	0.31	15	957	627	4 24	59.0
8000	63 45	73 34	0.30	16	960	635	4 31	59.5
7900	64 8	73 56	0.29	17	963	647	4 38	59.8
7800	64 32	74 18	0.28	19	965	658	4 45	60.0
7700	64 55	74 39	0.27	20	967	662	4 53	60.2
7600	65 18	75 0	0.27	22	969	680	5 1	60.5
7500	65 39	75 20	0.26	24	971	690	5 10	60.8
7400	66 0	75 41	0.25	26	973	700	5 19	61.0
7300	66 21	76 2	0.25	28	975	710	5 28	61.2
7200	66 42	76 23	0.24	29	977	720	5 37	61.5
7100	67 5	76 44	0.23	31	980	732	5 47	61.8
7000	67 27	77 5	0.23	33	982	745	5 58	62.0
6900	67 48	77 25	0.22	35	984	755	6 9	62.3
6800	68 9	77 45	0.22	37	986	765	6 20	62.5
6700	68 30	78 5	0.21	39	988	775	6 31	62.8
6600	68 51	78 24	0.20	41	990	785	6 42	63.0
6500	69 15	78 45	0.20	43	992	797	6 54	63.2
6400	69 40	79 5	0.20	46	994	810	7 6	63.5
6300	69 50	79 24	0.19	48	996	805	7 19	63.8
6200	70 0	79 44	0.18	50	998	820	7 32	64.2

# RANGE TABLE for 9-inch R.M.L. Gun, Mark VIA.

Based on Practice of 28. 11. 92.

Charge { weight, 37½ lb.  
gravimetric density,  $\frac{42.1}{0.659}$ .  
nature of powder, S.P.  
W.A., lot 4720.

Projectile { nature, Palliser.  
weight, 360 lb.  
Muzzle velocity, 982 f.s.

Nature of Mounting, High-Angle Fire Mounting, R.C.D. No. 1280 A.

Range.	Elevation.	Angle of Descent.	Slope of Descent.	5 minutes elevation will alter Range by	Remain- ing Velocity.	Drift Right.	Drift Angle.	Time of Flight.
yards.	° ' "	° ' "	1 in.	yards.	f.s.	yards.	° ' "	seconds.
7400	30 0	37 56	1.3	14	798	118	0 55	30.0
7500	30 49	40 13	1.2	12	806	129	0 59	31.1
7600	31 38	42 30	1.0	10	815	140	1 2	32.3
7700	32 32	44 37	1.0	8	823	151	1 6	33.4
7800	33 27	46 54	0.9	7	831	163	1 9	34.6
7900	34 31	48 57	0.9	6	838	173	1 13	35.8
8000	35 35	51 0	0.8	5	846	184	1 18	37.0
8100	37 2	52 44	0.8	4	853	195	1 24	38.1
8200	38 30	54 28	0.7	4	860	206	1 30	39.2
8300	42 36	55 56	0.7	4	865	234	1 37	40.2
8400	47 0	57 21	0.6	4	871	263	1 44	41.2
8500	49 9	58 37	0.6	5	876	291	1 52	42.3
8600	51 18	59 51	0.6	5	882	319	2 0	43.3
8700	52 36	60 51	0.5	6	886	332	2 8	44.4
8800	53 54	61 51	0.5	7	890	345	2 17	45.4
8900	54 34	62 46	0.5	8	894	356	2 26	46.3
9000	55 53	63 42	0.5	9	898	368	2 36	47.2
9100	56 45	64 33	0.5	10	901	379	2 46	48.1
9200	57 37	65 24	0.5	10	905	390	2 55	49.0
9300	58 18	66 9	0.4	11	908	400	3 4	49.8
9400	59 0	66 54	0.4	11	911	410	3 13	50.6
9500	59 38	67 7	0.4	11	914	420	3 23	51.5
9600	60 17	68 19	0.4	12	917	429	3 32	52.3
9700	60 52	68 57	0.4	13	920	437	3 42	52.9
9800	61 27	69 36	0.4	13	922	446	3 51	53.6
9900	61 58	70 12	0.4	14	925	454	4 0	54.2
10000	62 30	70 48	0.3	14	927	462	4 9	54.9
10100	63 1	71 21	0.3	15	929	469	4 17	55.4
10200	63 32	71 54	0.3	16	931	476	4 26	56.0
10300	64 1	72 25	0.3	16	934	482	4 34	56.5
10400	64 30	72 56	0.3	16	936	489	4 43	57.0
10500	64 58	73 26	0.3	17	938	495	4 51	57.5
10600	65 27	73 56	0.3	17	940	502	4 59	58.0
10700	65 54	74 23	0.3	18	942	507	5 7	58.5
10800	66 21	74 50	0.3	18	943	512	5 15	59.0
10900	66 49	75 16	0.3	18	945	519	5 22	59.5
11000	67 17	75 42	0.3	18	947	526	5 30	60.0
11100	67 43	76 9	0.3	18	949	531	5 37	60.4
11200	68 10	76 36	0.2	18	951	537	5 45	60.8
11300	68 36	77 1	0.2	19	952	543	5 52	61.2
11400	69 3	77 26	0.2	19	954	549	7 0	61.6
11500	69 28	77 55	0.2	19	956	554	7 7	62.0
11600	69 54	78 24	0.2	19	958	560	7 17	62.4
11700	70 0	78 30	0.2	19	959	562	7 20	62.5



# RANGE TABLE for 9-inch R.M.L. Gun, Mark VIA.

Based on Practice of 28.11.92.

Charge	{	weight, 25 lb.		Projectile	{	nature, Palliser.
		gravimetric density, $\frac{63.2}{0.438}$ .				weight, 360 lb.
		nature of powder, S.P.				Muzzle velocity, 755 f.s.
		W.A., lot 4720.				

Nature of Mounting, High-Angle Fire Mounting, R.C.D. No. 1250 A.

Range.	Elevation.	Angle of Descent.	Slope of Descent.	5 minutes' elevation will alter Range by	Remain- ing Velocity.	Drift Right.	Drift Angle.	Time of Flight.
yards.	° /	° /	1 in.	yards.	f.s.	yards.	° /	seconds.
4630	30 0	35 4	1.4	8	620	78	0 52	23.3
4700	31 0	38 11	1.2	7	627	85	0 59	25.1
4800	32 0	41 18	1.1	6	633	93	1 6	26.8
4900	33 21	44 12	1.0	5	640	101	1 23	28.6
5000	34 42	47 6	0.9	4	648	110	1 53	30.5
5100	36 30	49 51	0.8	4	655	118	1 58	32.3
5200	38 18	52 36	0.7	3	662	127	2 3	34.0
5300	43 0	55 6	0.7	2	668	172	2 7	35.3
5200	48 42	57 36	0.6	2	674	200	2 12	37.0
5100	51 21	59 45	0.6	2	679	207	3 10	38.1
5000	54 0	61 54	0.5	3	685	214	4 8	39.2
4900	55 32	63 34	0.5	5	690	220	5 2	40.1
4800	57 6	65 15	0.5	6	695	226	5 56	41.0
4700	58 18	67 28	0.4	6	698	233	6 41	41.9
4600	59 30	69 42	0.4	6	702	240	7 27	42.8
4500	60 30	70 28	0.3	7	705	246	8 3	43.6
4400	61 30	71 15	0.3	8	708	252	8 39	44.5
4300	62 21	71 55	0.3	9	711	258	9 9	45.5
4200	63 12	72 36	0.3	10	713	267	9 38	46.5
4100	64 0	73 1	0.3	10	715	273	10 2	47.5
4000	64 48	73 46	0.3	10	717	278	10 26	48.5
3900	65 33	74 17	0.3	10	719	284	10 43	49.5
3800	66 18	74 48	0.3	10	721	291	11 0	50.5
3700	67 0	75 18	0.3	10	722	297	11 16	51.3
3600	67 42	75 48	0.3	10	724	304	11 33	52.2
3500	68 23	76 18	0.2	10	725	311	11 49	53.3
3400	69 4	76 48	0.2	10	727	317	12 4	54.2

# RANGE TABLE for 9-inch R.M.L. Gun, Mark VIa.

Based on Practice of 28.11.92.

Charge { weight,  $12\frac{1}{2}$  lb.  
gravimetric density,  $\frac{126.4}{0.219}$   
nature of powder, S.P.  
W.A., lot 4720.

Projectile { nature, Palliser.  
weight, 360 lb.  
Muzzle velocity, 530 f.s. (estimated).

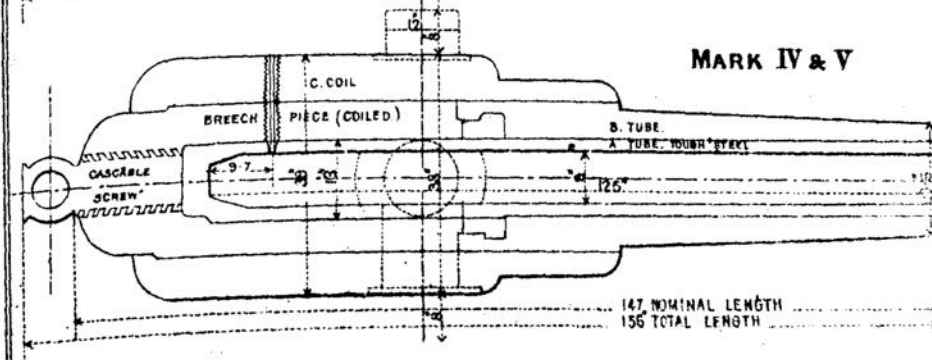
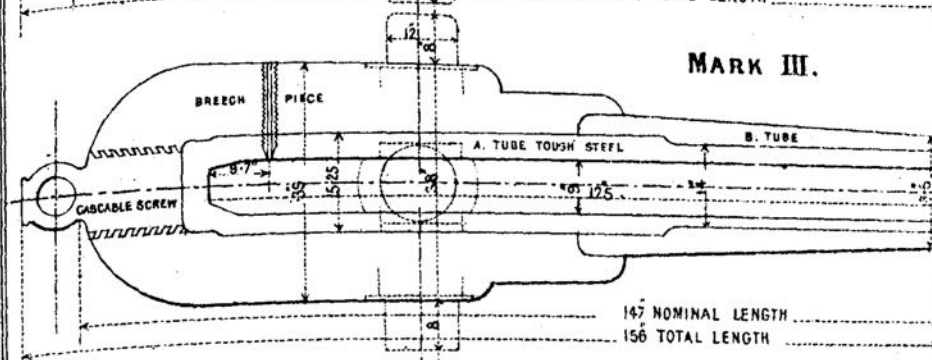
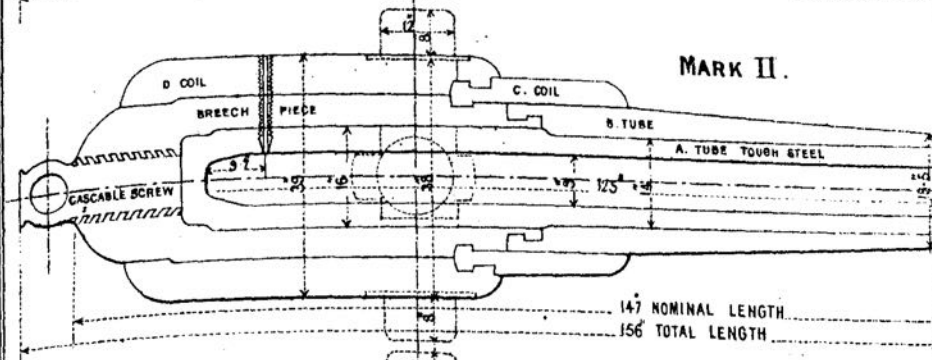
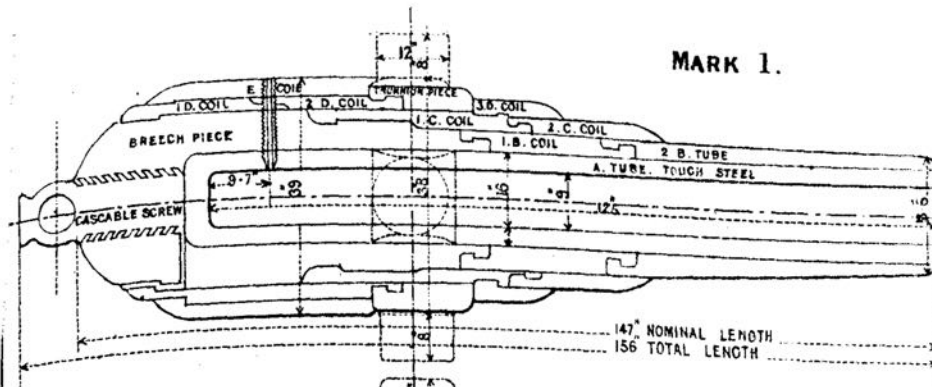
Nature of Mounting, High-Angle Fire Mounting, R.C.D. No. 1280 A.

Range.	Elevation.	Angle of Descent.	Slope of Descent.	5 minutes' elevation will alter Range by	Remain- ing Velocity.	Drift Right.	Drift Angle.	Time of Flight.
	° / '	° / '	1 in.	yards.	f.s.	yards.	° / '	seconds.
yards. 2000	31 15	33 18	1.3	3	430	32	0 55	14.8
2100	33 30	41 6	1.1	3	439	38	1 24	16.8
2200	36 3	46 39	0.9	3	447	44	1 57	18.2
2300	39 30	52 12	0.7	2	452	50	2 30	19.6
2330	43 30	53 39	0.7	1	455	57	2 33	20.5
2300	46 24	55 6	0.7	1	459	63	2 48	21.5
2200	52 42	58 40	0.6	1	464	82	3 21	23.2
2100	56 21	62 15	0.5	1	470	99	3 55	24.6
2000	59 9	65 15	0.5	1	475	117	4 32	26.0
1900	61 24	68 12	0.4	2	479	134	5 9	27.5
1800	63 27	70 36	0.4	2	483	151	5 47	28.6
1700	65 22	73 0	0.3	3	485	168	6 25	29.8
1600	67 12	75 7	0.3	4	487	185	7 3	31.3
1500	69 2	77 15	0.2	5	488	203	7 42	32.8

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RIFLED, MUZZLE LOADING, 9 INCH GUNS OF 12 TONS

SCALE  $\frac{3}{8}$  INCH = 1 FOOT.



# ORDNANCE. R.M.L. 9 INCH. MARK $\frac{VIA}{IV}$ .

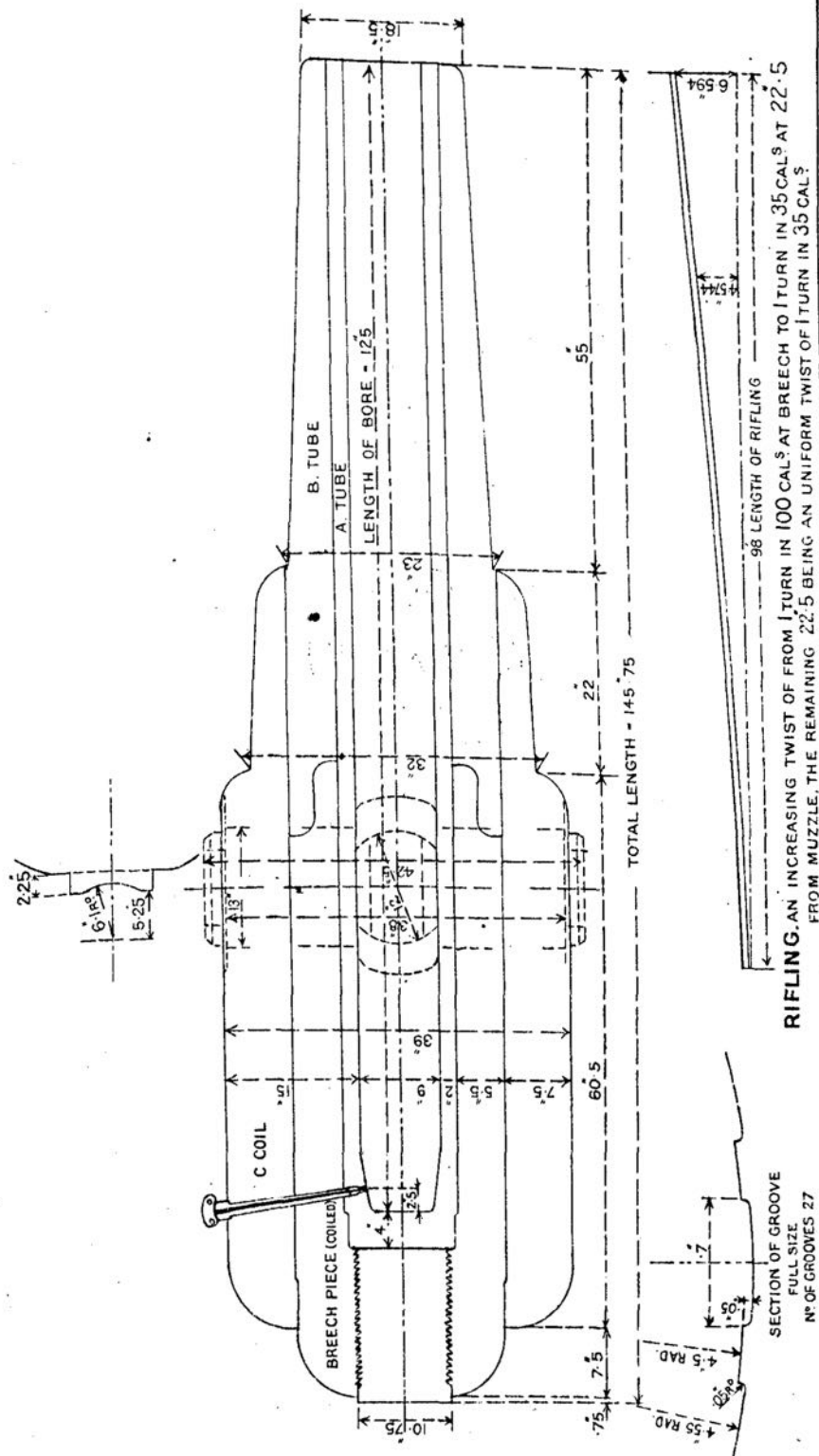
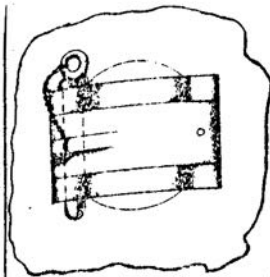


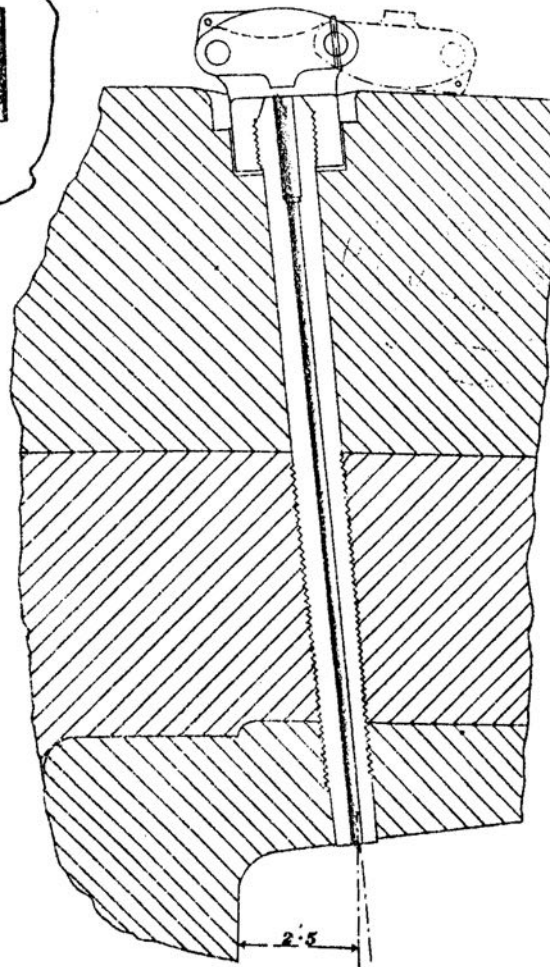
Plate II.

ORDNANCE, R.M.L. 9-INCH. MARK VI.A  
VENTING

Scale  $\frac{1}{4}$



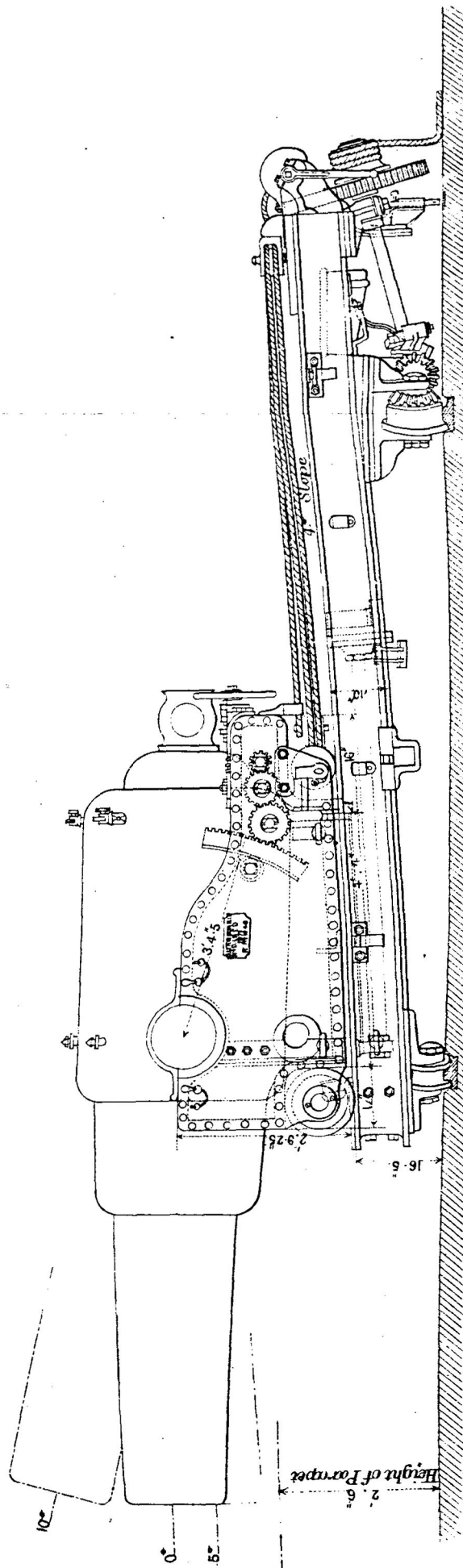
PLAN.



COMMON, R. M. L. 3 INCH, CASEMATE OR DWARF.

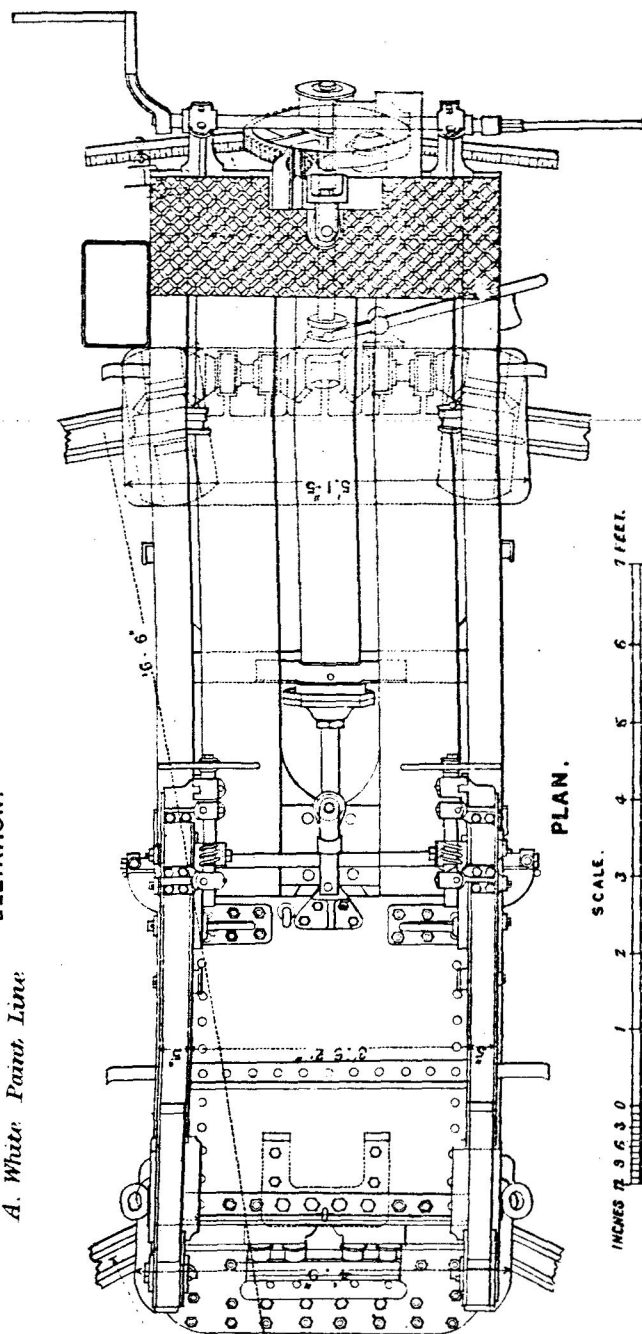
# SLIDE, R. M. L. 9 INCH, CASEMATE.

FITTED WITH SIDE GEAR.



ELEVATION.

A. White Paint Line



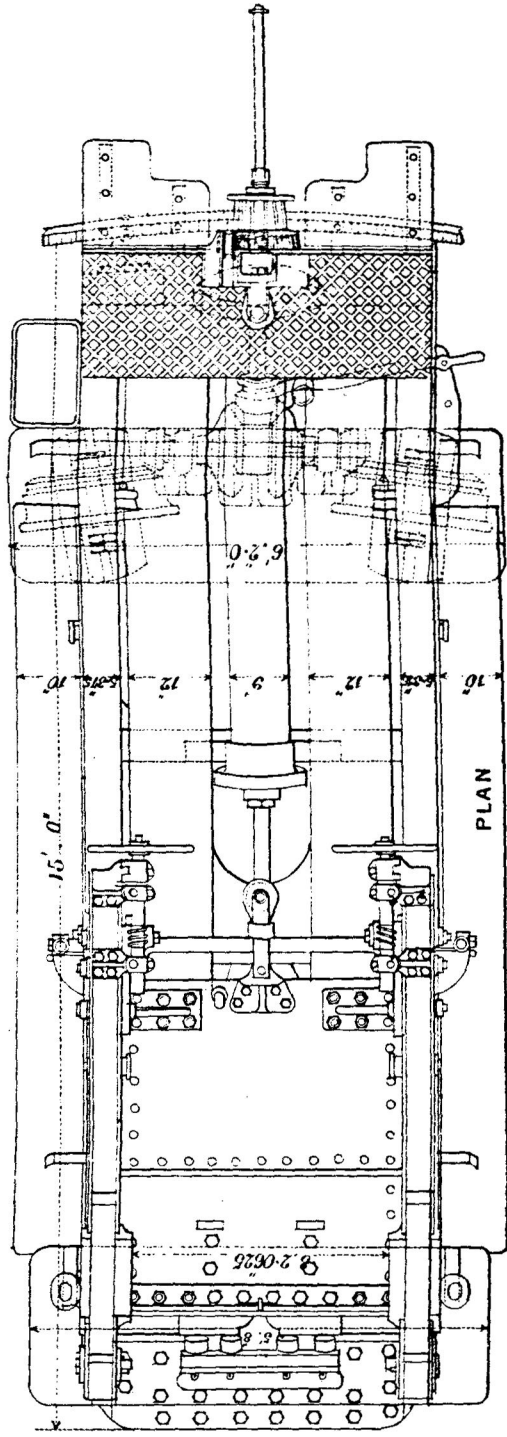
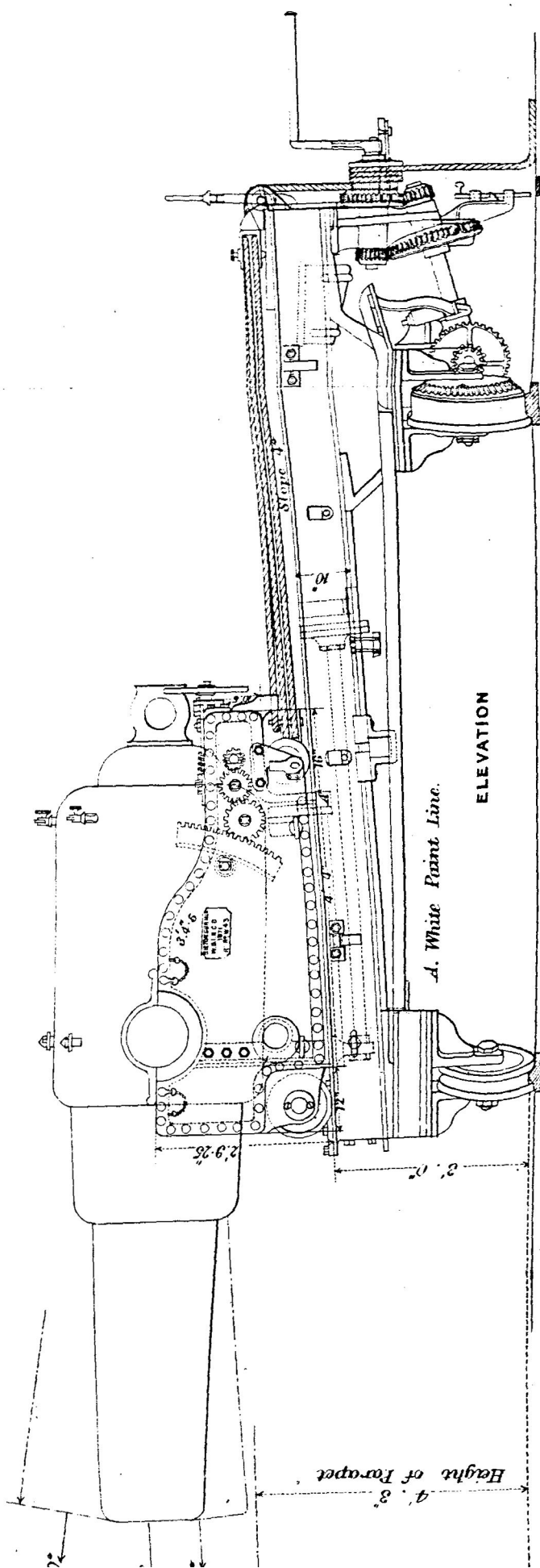
PLAN.

SCALE.  
INCHES 12 9 6 3 0  
1 2 3 4 5 6 7 FEET.

NOTE. In future manufacture the winch handles of traversing gear will be arranged to work within the Platform.

# SLIDE, R.M. L. 9 INCH DWARF "A".

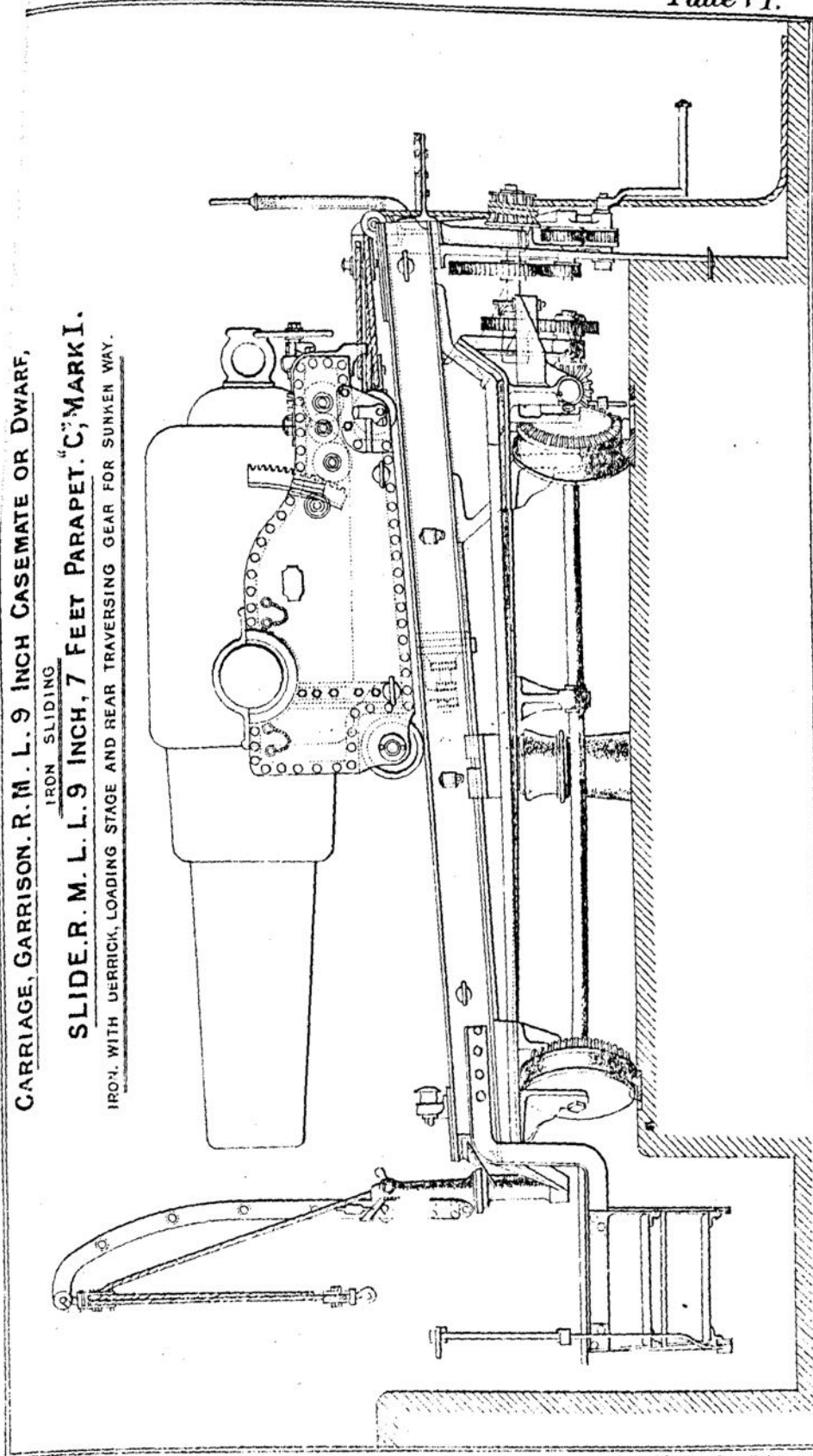
FITTED FOR "A" PIVOT.



SCALE. 1" = 1' 0"



CARRIAGE, GARRISON. R. M. L. 9 INCH CASEMATE OR DWARF,  
IRON SLIDING  
SLIDE. R. M. L. 9 INCH, 7 FEET PARAPET. "C" MARK I.  
IRON. WITH DERRICK, LOADING STAGE AND REAR TRAVERSING GEAR FOR SUNKEN WAY.

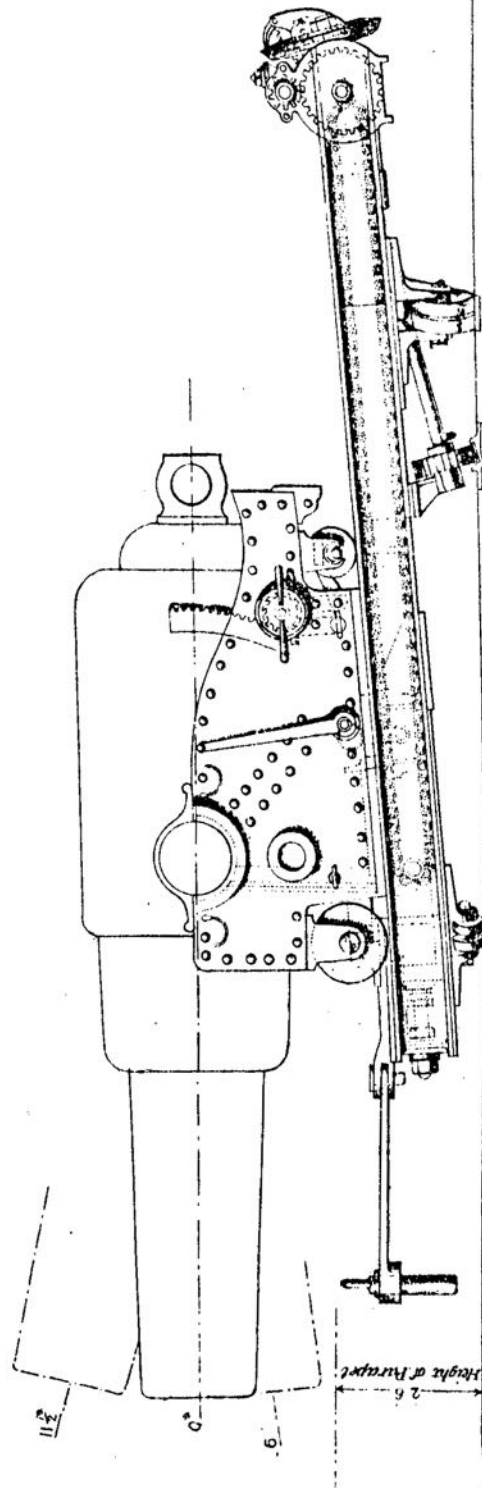


CARRIAGE, GARRISON, R. M. L. 9 INCH. S. P. CONVERTED, NAVAL.

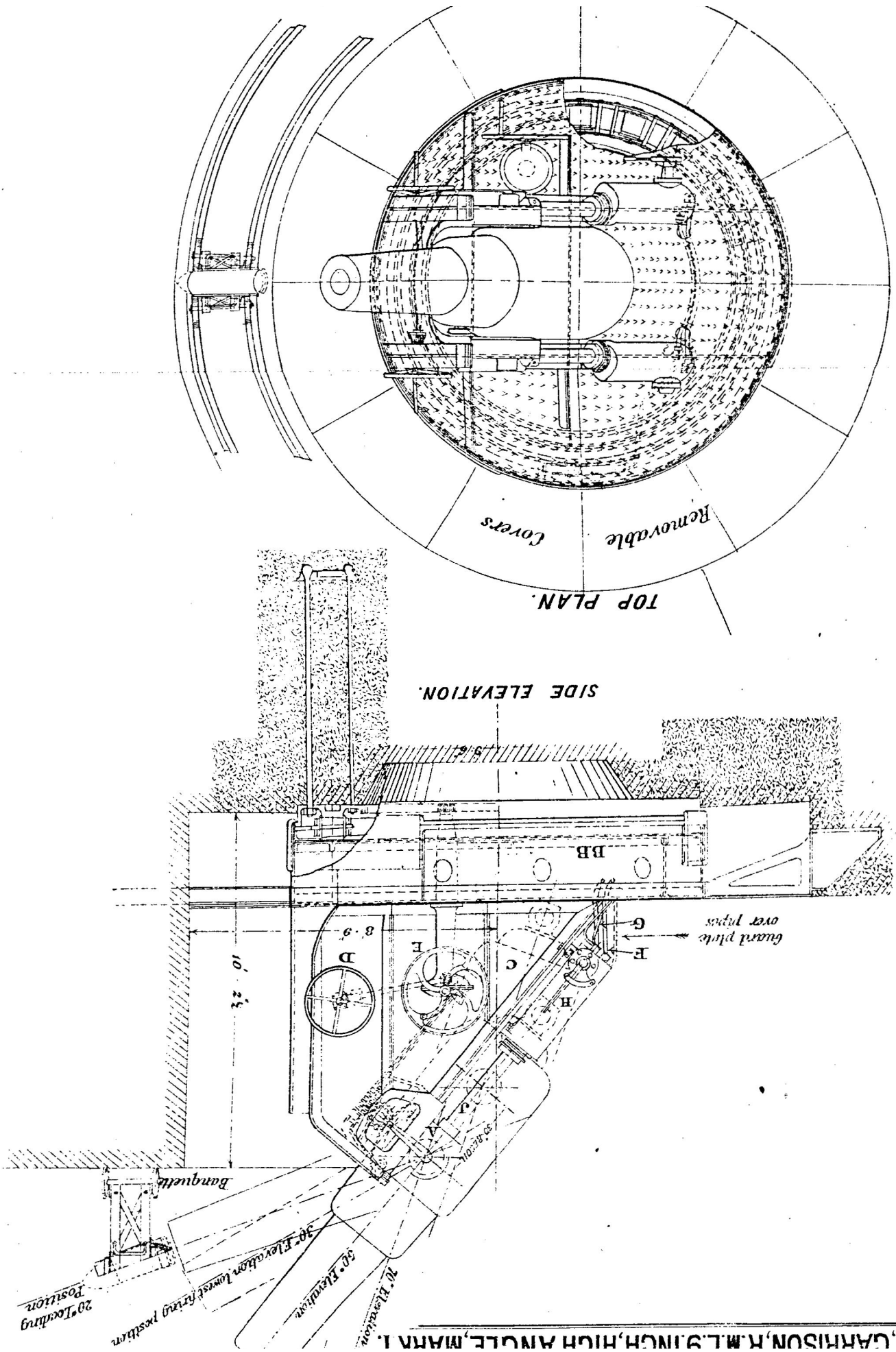
IRON FOR SLIDE CONVERTED.

SLIDE L. R. M. L. 9 INCH. CONVERTED SLIDE.

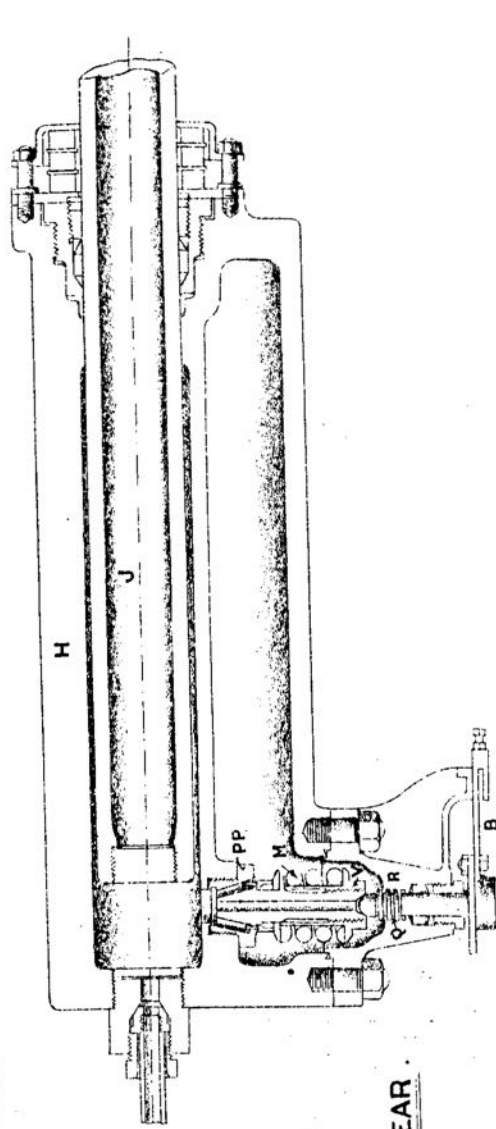
(IRON 4° SLOPE FOR CONVERTED NAVAL S. P. CARRIAGE.)



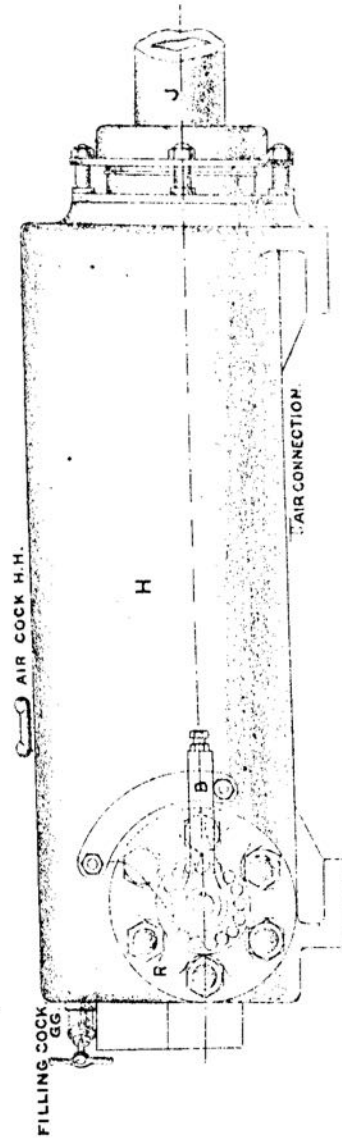
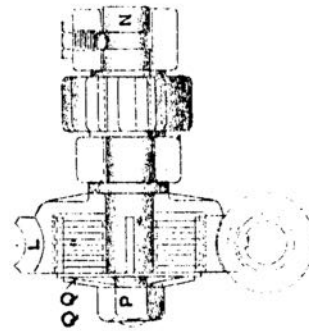
SIDE ELEVATION.



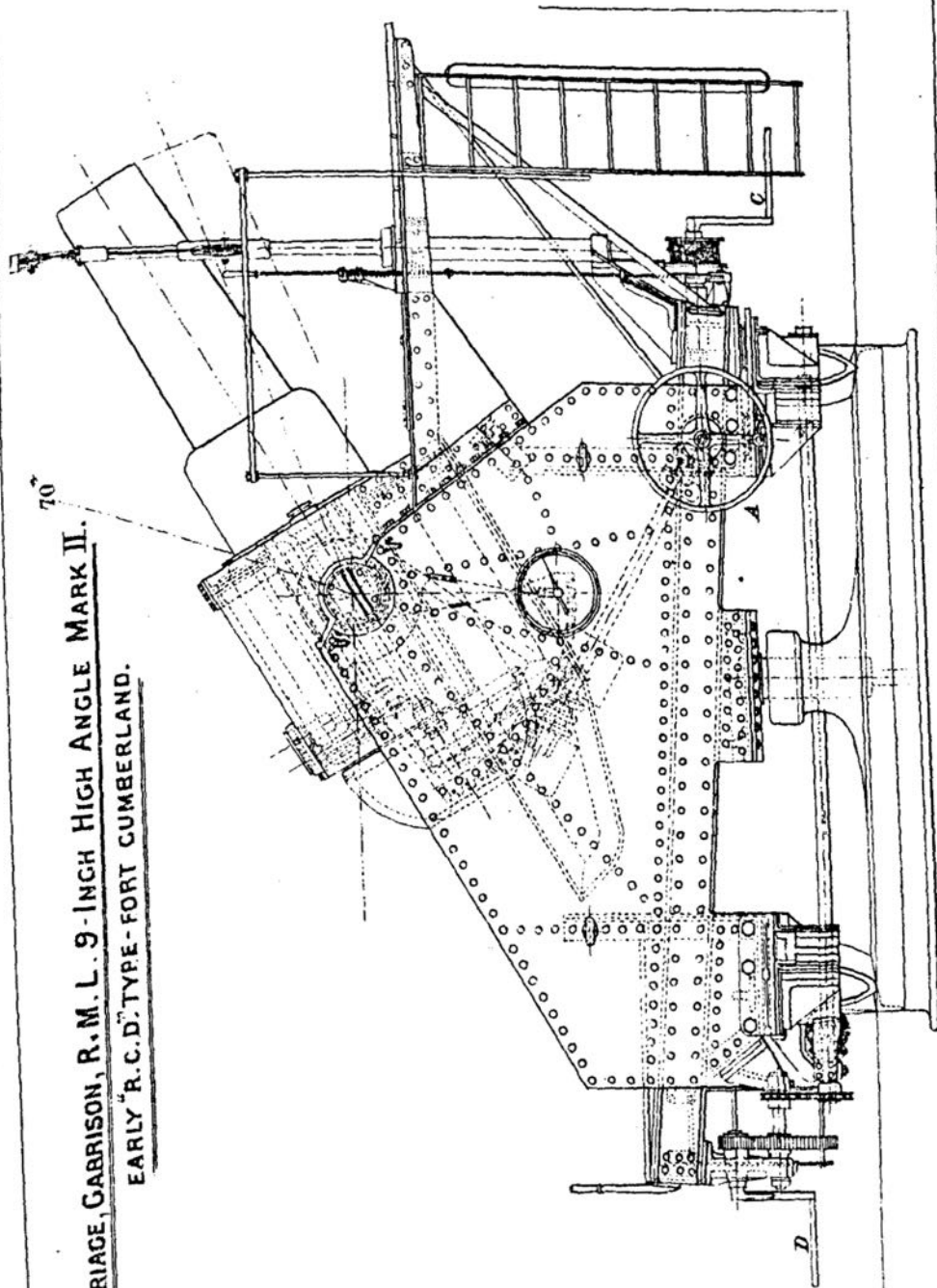
SECTION OF R. H. RECOIL CYLINDER. CARRIAGE 9 INCH HIGH ANGLE MARK I.



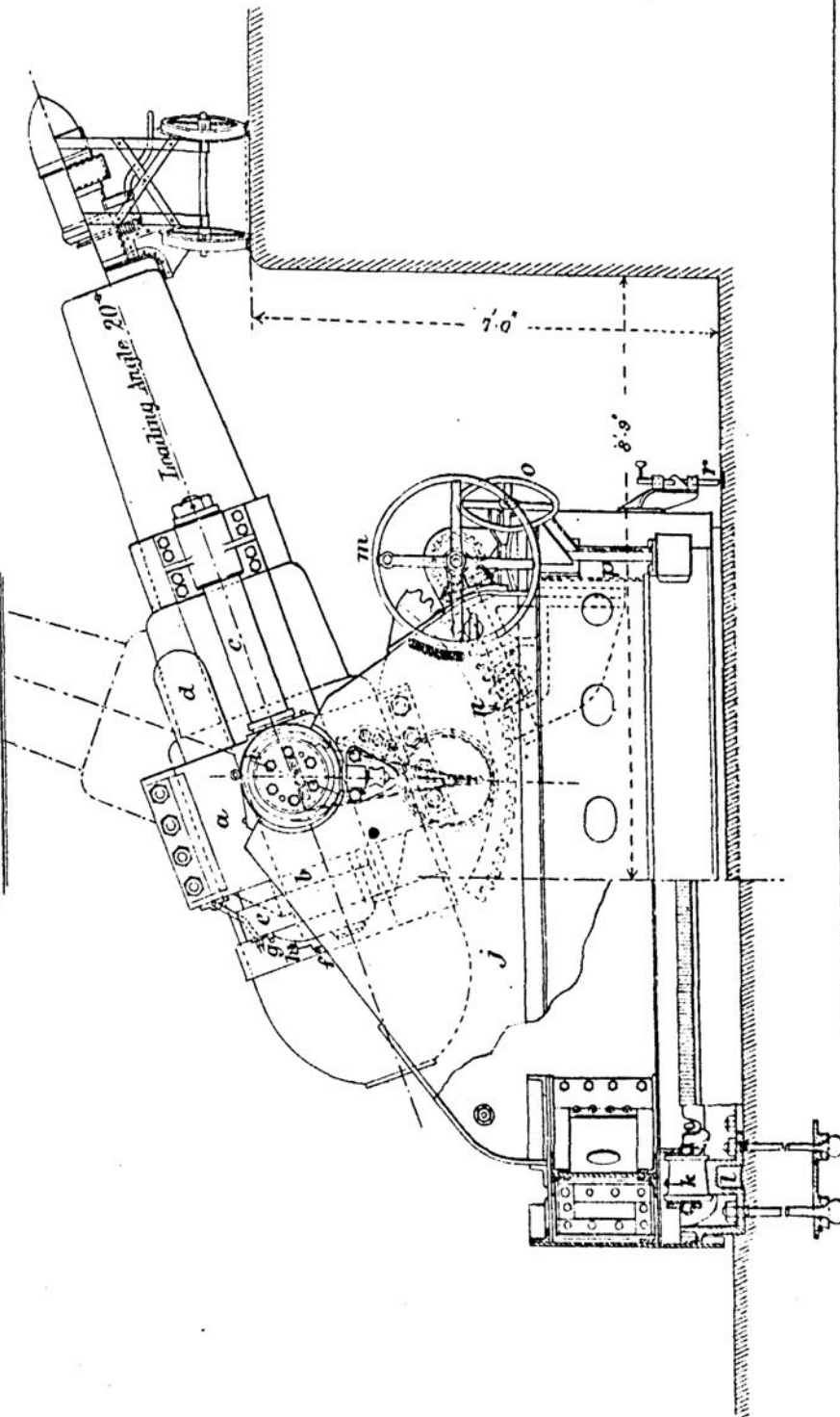
SECTION OF ELEVATING GEAR .



70°  
 CARRIAGE, GARRISON, R. M. L. 9-INCH HIGH ANGLE MARK II.  
 EARLY "R. C. D." TYPE - FORT CUMBERLAND.

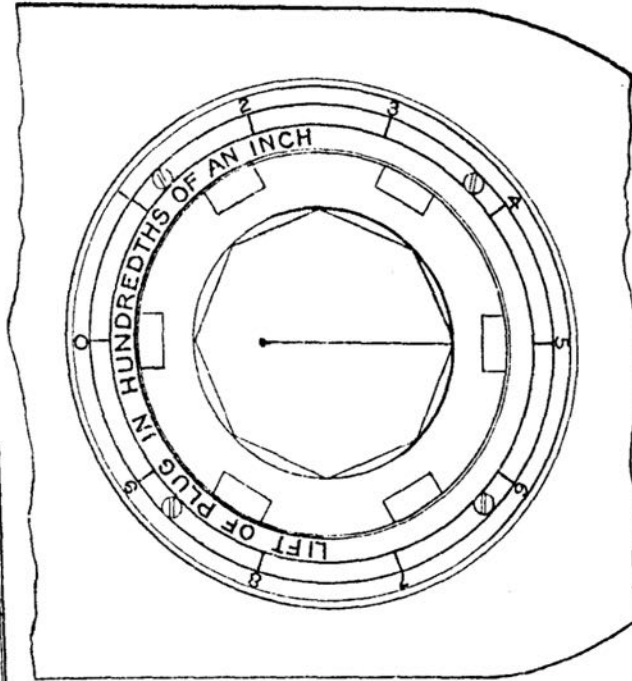
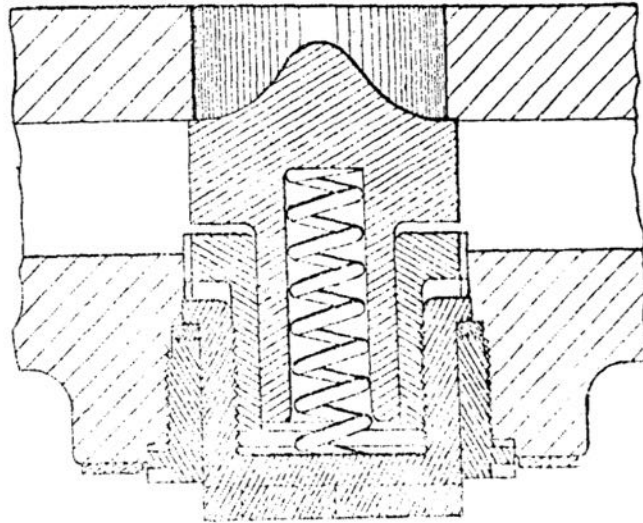


— CARRIAGE, GARRISON R.M.L. 9-INCH HIGH ANGLE MARK III. —  
 — STEEL WITH ROLLER RING —



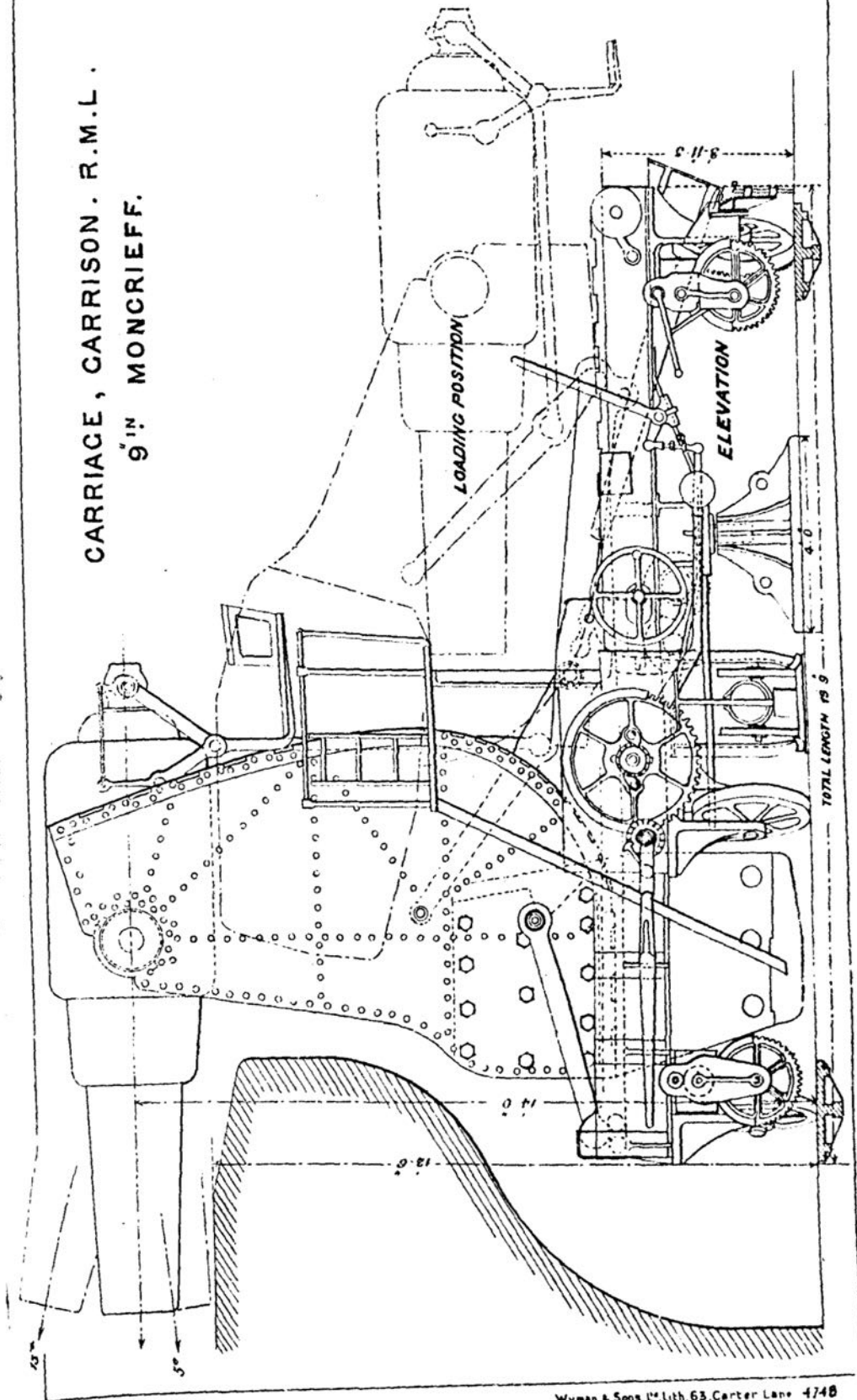
CARRIAGE GARRISON R.M.L. HIGH ANGLE 9&10 INCH MARK III.

Scale  $\frac{2}{3}$ ths



VALVE RECOIL.

CARRIAGE, CARRISON . R.M.L. .  
9" MONCRIEFF.





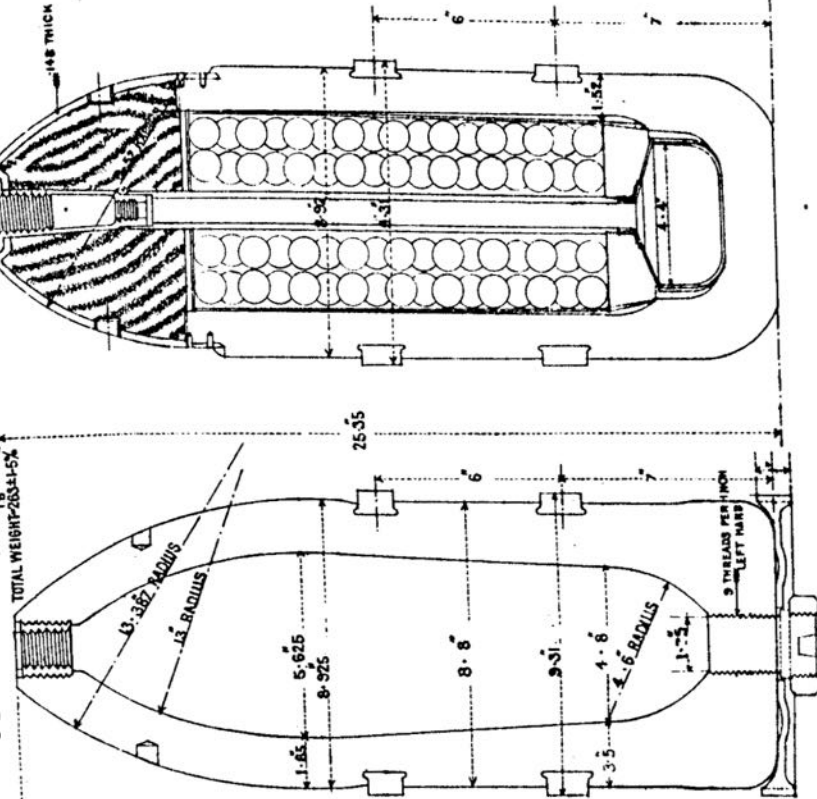
PROJECTILES R. M. L. 9 INCH. STUDDED.

SHRAPNEL III

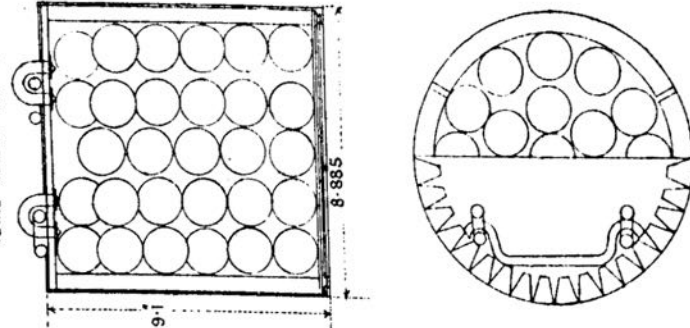
SCALE 1/2

COMMON VI.

15 LB  
TOTAL WEIGHT 254.8 ± 5%

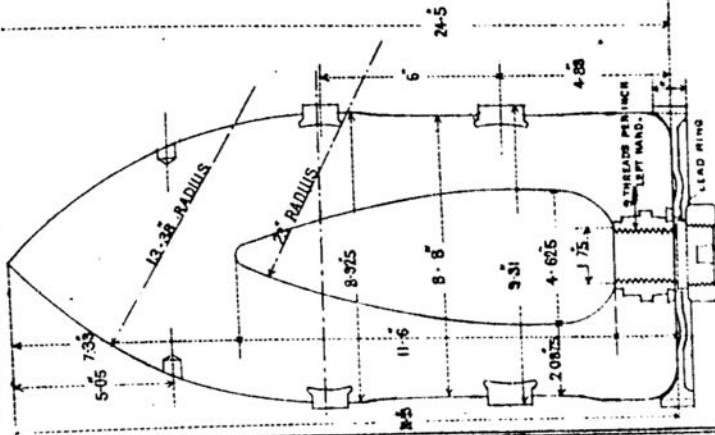


IRON CASE SHOT. V.  
15 LB  
TOTAL WEIGHT 107 ± 5



PALLISER VII.

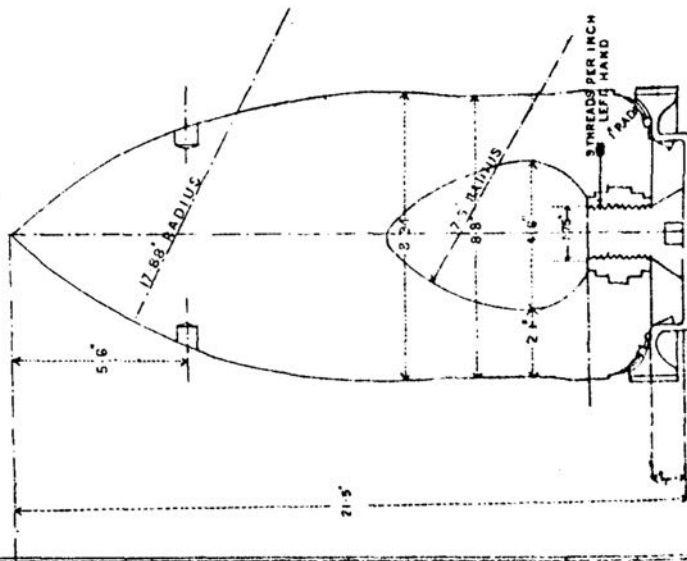
15 LB  
TOTAL WEIGHT 257.15 ± 75%



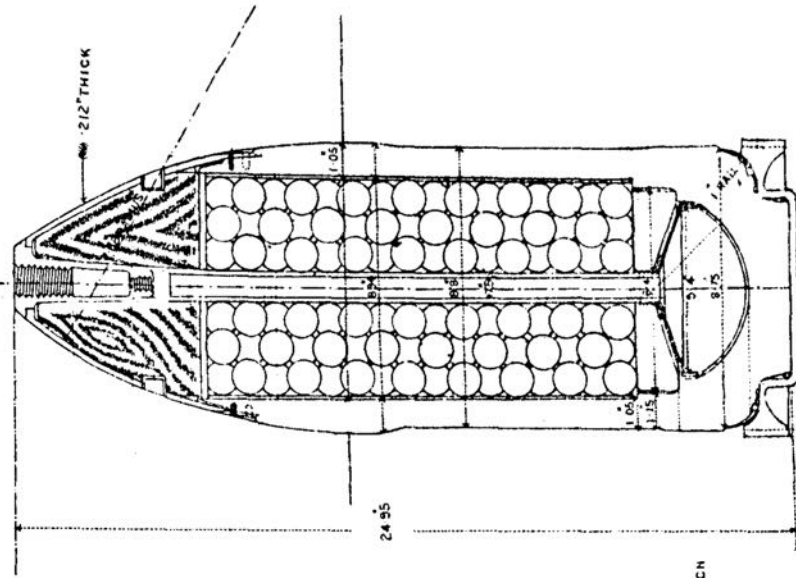
PROJECTILES R.M.L. 9 INCH STUDLESS.

SCALE  $\frac{1}{2}$

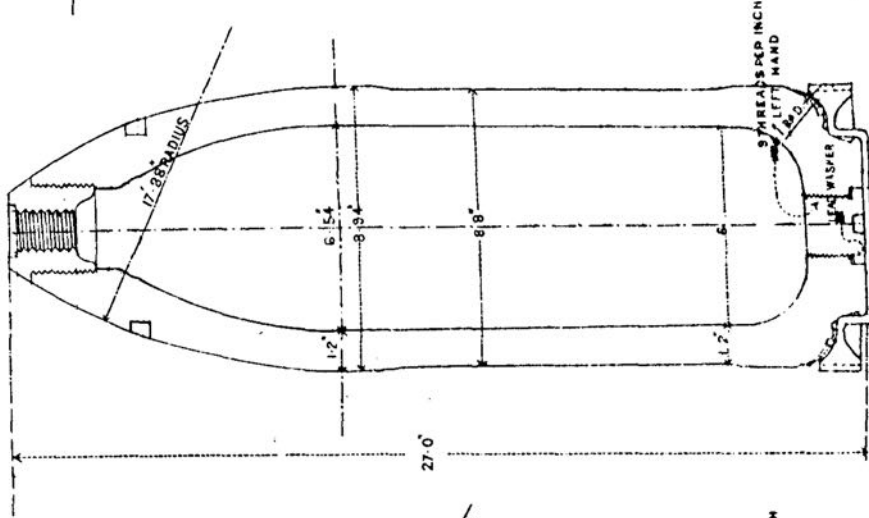
PALLISER II.



SHRAPNEL. CAST STEEL II.

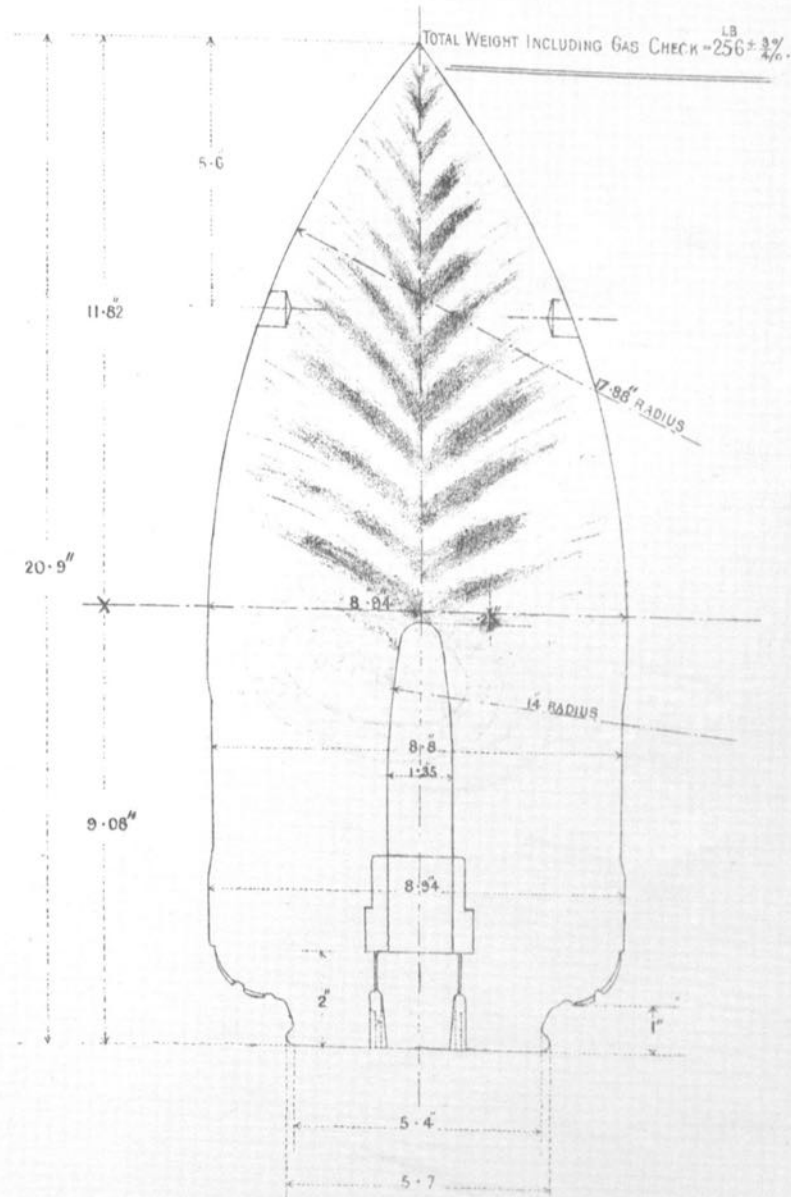


COMMON CAST STEEL II.



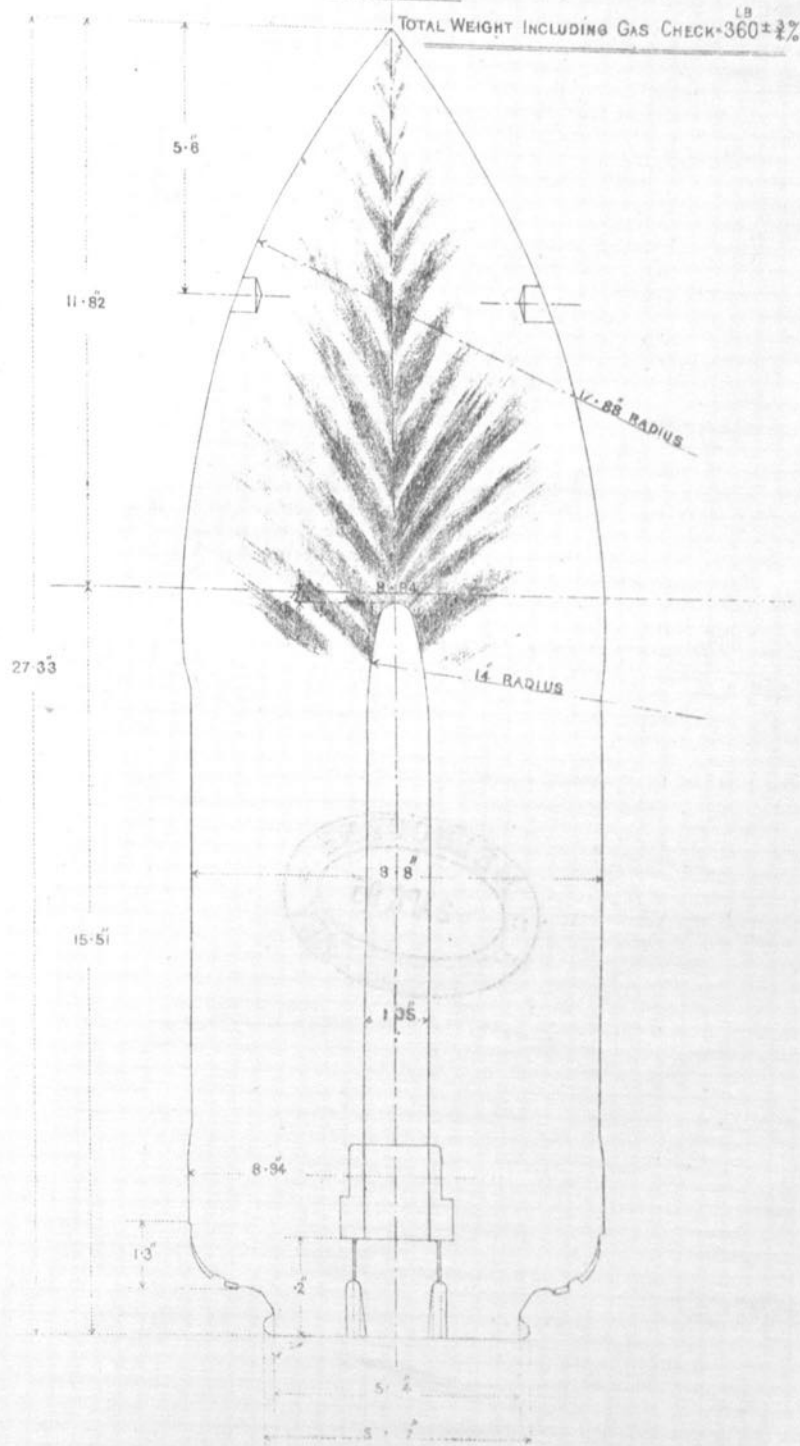
SHOT R. M. L. PALLISER, 9 INCH. STUDLESS. MARK III.

SCALE  $\frac{1}{4}$ .



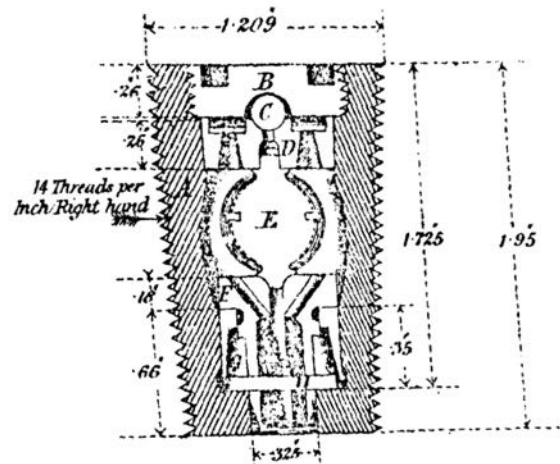
SHOT. R. M. L. PALLISER, 9 INCH. STUDLESS, HEAVY, MARK I.  
360 LB. FOR MARK VI. GUNS WHEN ON HIGH ANGLE MOUNTINGS.

SCALE  $\frac{1}{4}$ .



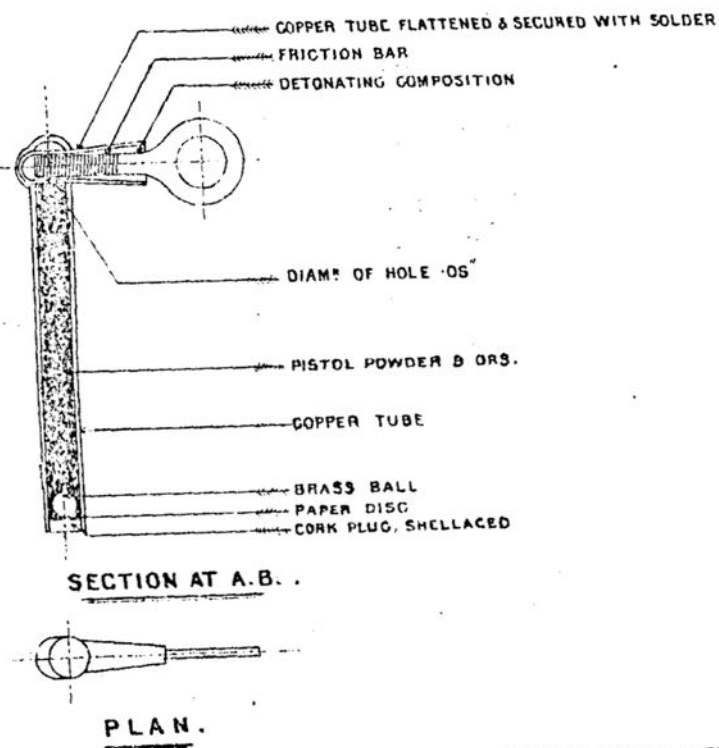
**FUZE PERCUSSION PETTMAN GENERAL SERVICE N° 5. MARK II.**

*Full Size.*



**TUBE FRICTION COPPER SOLID DRAWN (MARK II)**

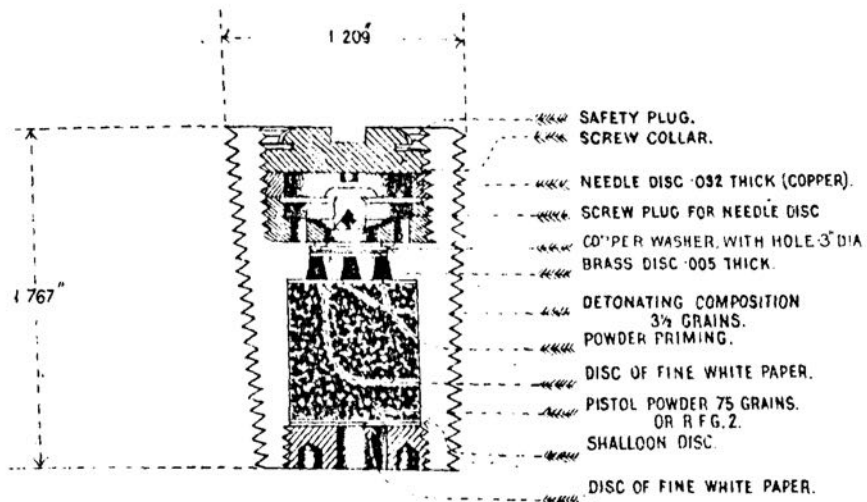
*Full Size.*



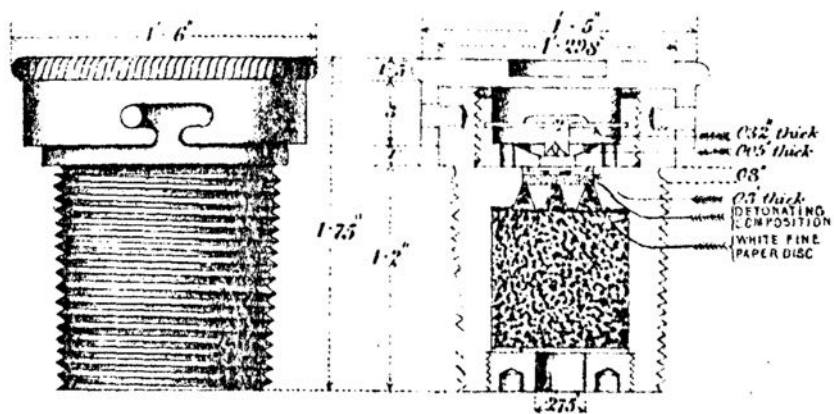
# FUZE, PERCUSSION, DIRECT ACTION N°3.

FULL SIZE.

## MARK III.

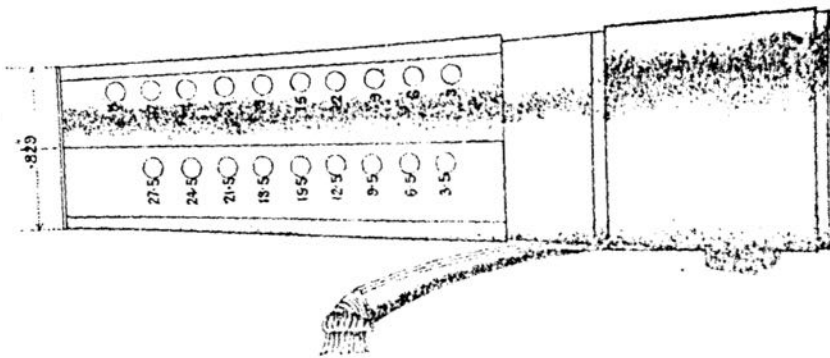
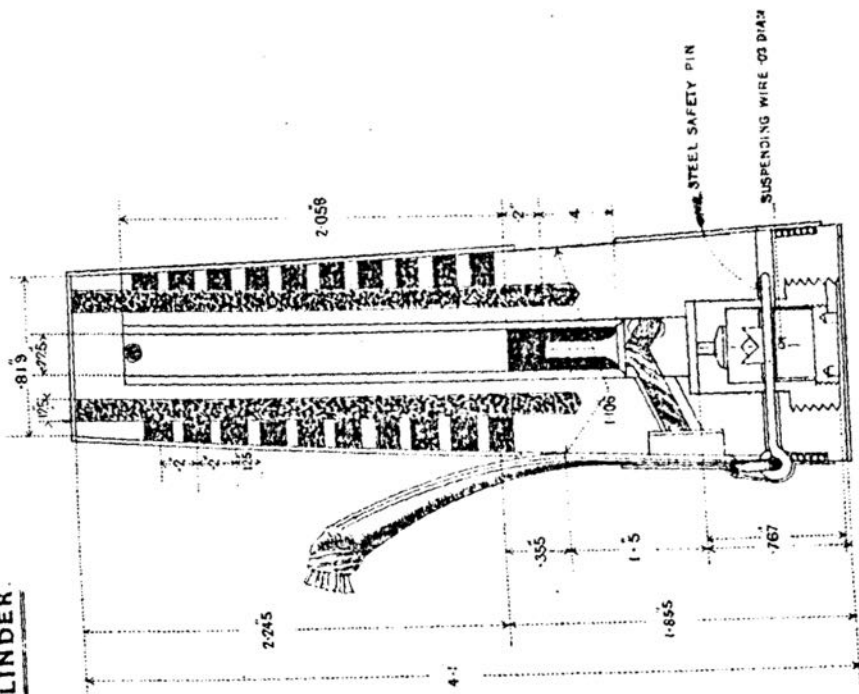


## MARK II.



FUZE, TIME 15 SECONDS, WITH DETONATOR. NO 43. MARK III.  
 WOOD, 5 IN A TIN CYLINDER.

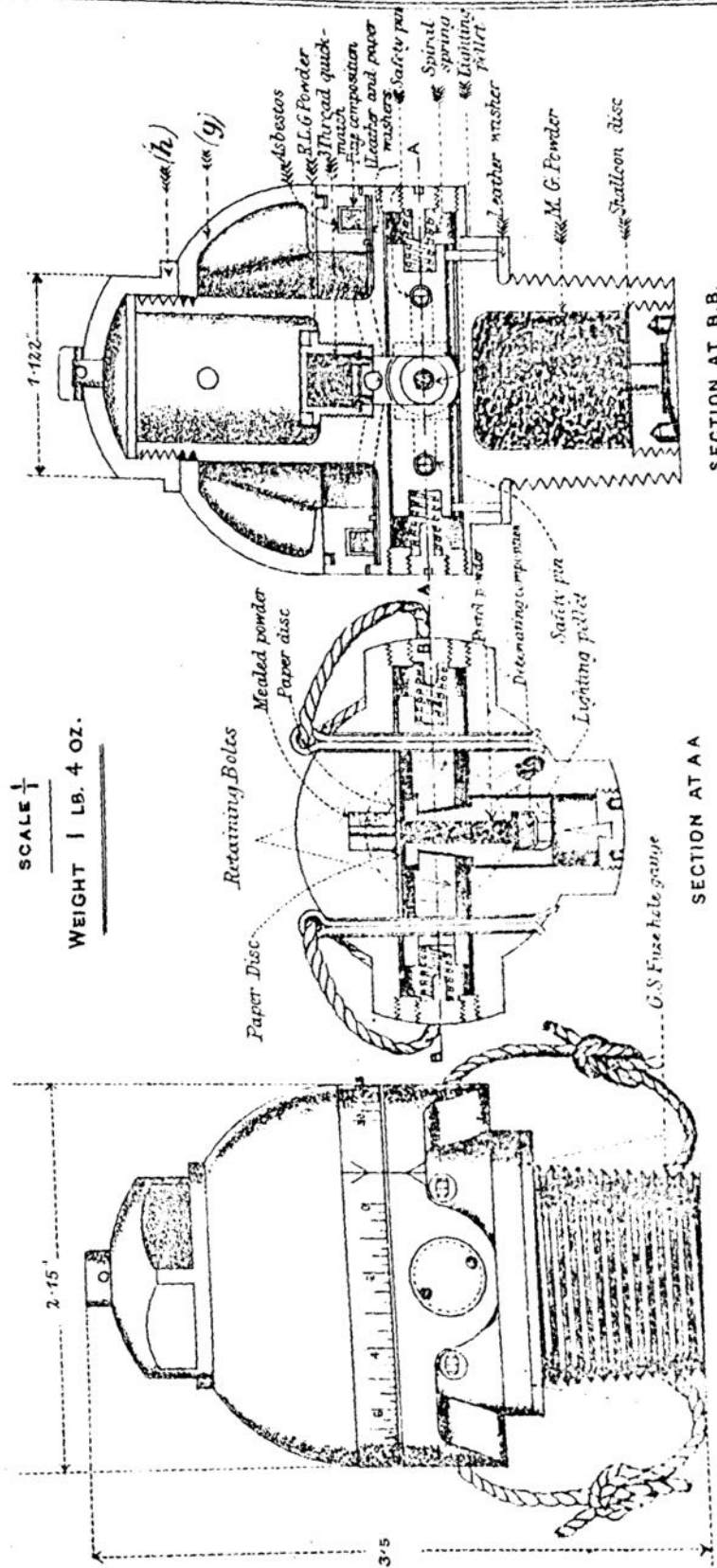
**FULL SIZE.**



# FUZE TIME SENSITIVE MIDDLE. NO 24. MARK I.

SCALE  $\frac{1}{4}$

WEIGHT 1 LB. 4 OZ.

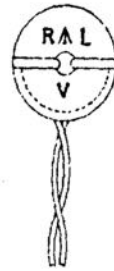
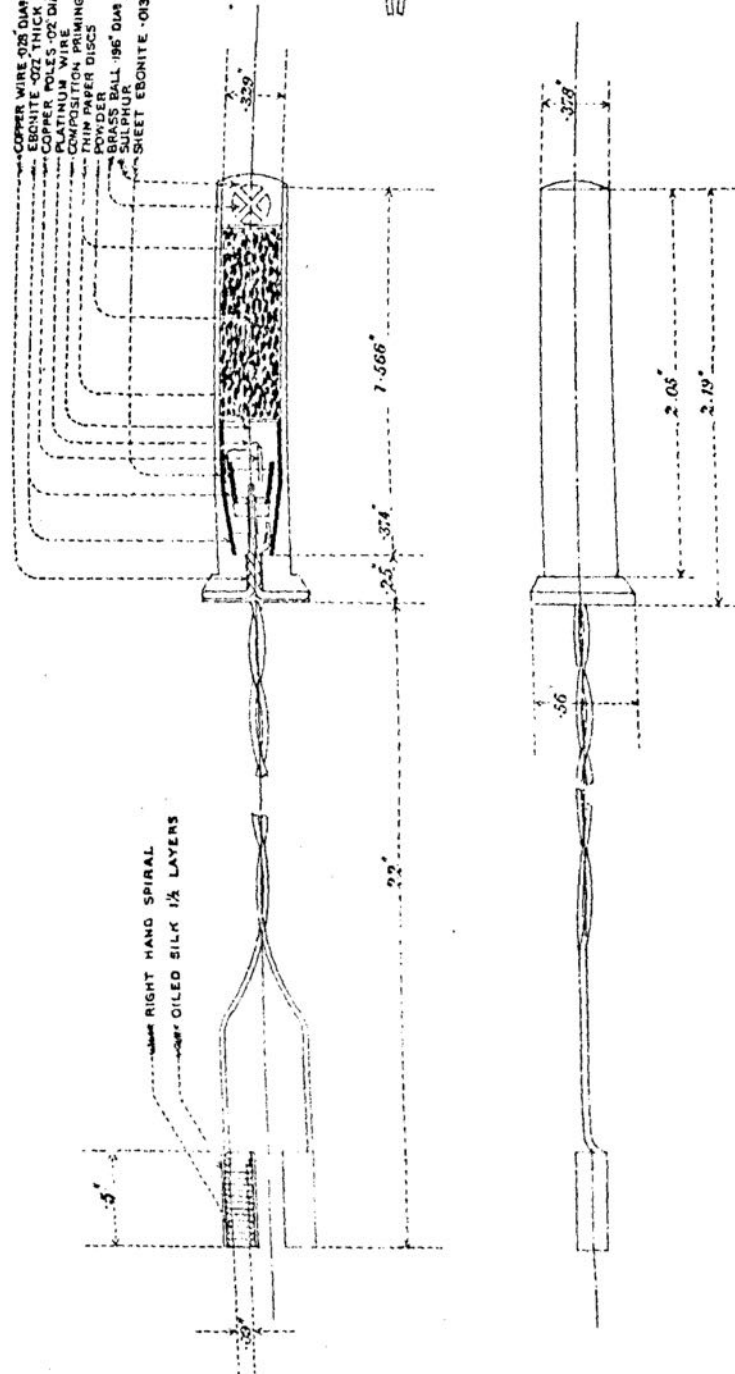




# TUBE VENT SEALING ELECTRIC P MARK V. BRASS FOR GUNS WITH PERCUSSION LOCKS.

FULL SIZE.

COPPER WIRE .025" DIA. COATED WITH PURE TIN, INSULATED WITH SILK  
EBONITE .002" THICK  
COPPER HOLES .02" DIA. COATED WITH PURE TIN  
PLATINUM WIRE  
COMPOSITION  
THIN PAPER DISCS  
POWDER  
GLASS BALL .196" DIA. TWO HOLES .045" DIA. AT RIGHT ANGLES  
SILK  
SHEET EBONITE .013" THICK.



END VIEW.

RIGHT HAND SPIRAL  
OILED SILK 1 1/2 LAYERS